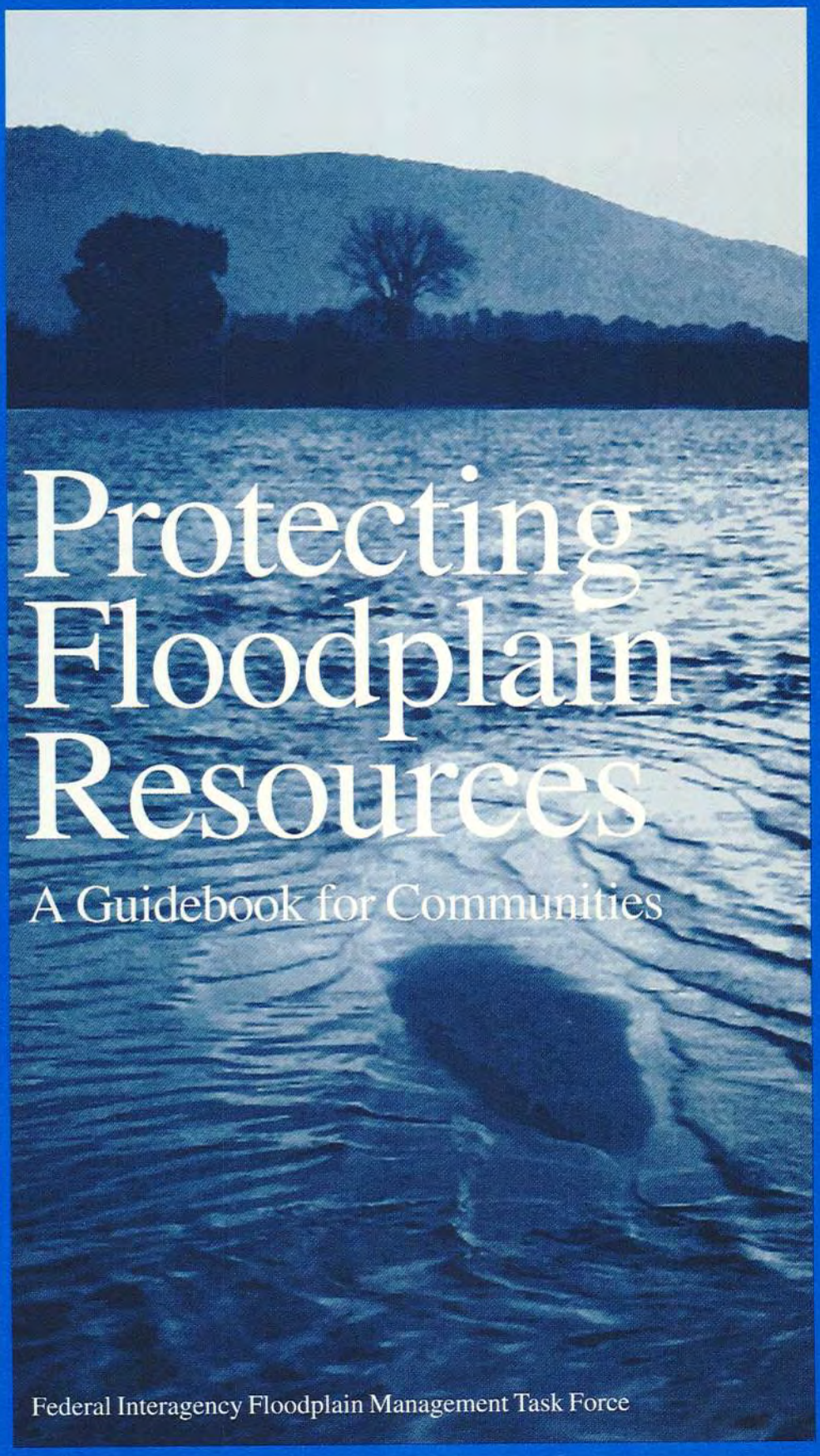

Protecting Floodplain Resources

A Guidebook for Communities

Federal Interagency Floodplain Management Task Force

PROTECTING FLOODPLAIN RESOURCES:
A Guidebook For Communities

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sponsored and funded by

Federal Interagency Floodplain Management Task Force

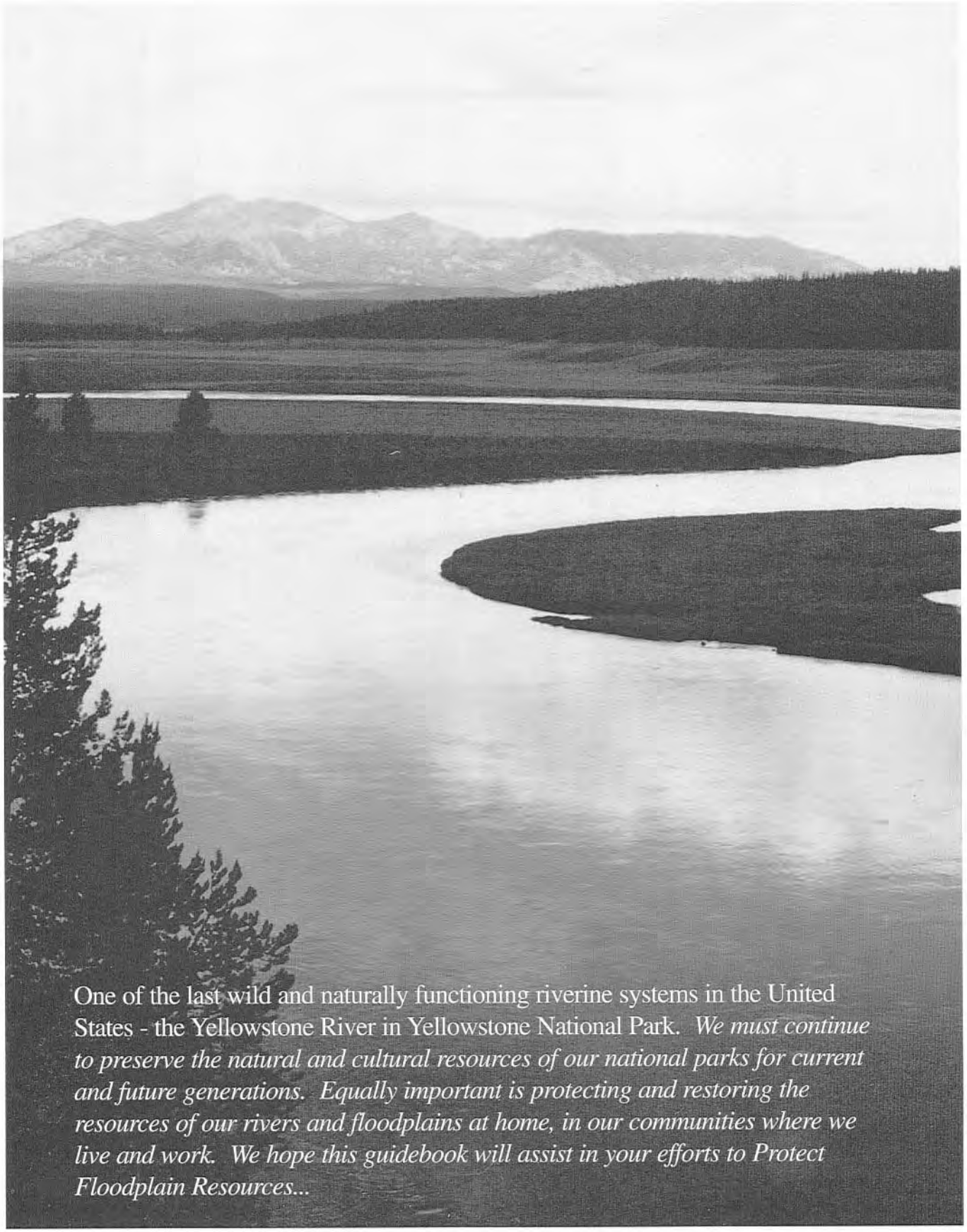
The Federal Interagency Floodplain Management Task Force was established in 1975 within the U.S. Water Resources Council to carry out the responsibility of the President to prepare for the Congress proposals necessary for a Unified National Program for Floodplain Management. In 1982 the Office of Management and Budget assigned responsibility for the Unified National Program to the Federal Emergency Management Agency, which assumed the role of chair of the Task Force. Membership of the Task force consists of the Departments of Agriculture, Army, Commerce, Energy, Housing and Urban Development, Interior, and Transportation; the Environmental Protection Agency; and the Tennessee Valley Authority.

PROTECTING FLOODPLAIN RESOURCES

A Guidebook
for
Communities

The Federal Interagency Floodplain
Management Task Force

2nd Edition - June 1996



One of the last wild and naturally functioning riverine systems in the United States - the Yellowstone River in Yellowstone National Park. *We must continue to preserve the natural and cultural resources of our national parks for current and future generations. Equally important is protecting and restoring the resources of our rivers and floodplains at home, in our communities where we live and work. We hope this guidebook will assist in your efforts to Protect Floodplain Resources...*

John H. McShane

Protecting Floodplain Resources

A Guidebook for Communities

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BACKGROUND

This guidebook is the result of an elaborate process carried out over a two year period. The authors initially met with the Federal Interagency Floodplain Management Task Force to define the scope, focus, and target audience for the guidebook. The authors then talked with representatives of the Association of State Floodplain Managers and prepared a mailback questionnaire to determine the specific needs and interests of local officials and private interest groups. From these discussions and questionnaires, the basic outline and specific information was modified and refined accordingly.

The final step was to prepare sequential drafts which were reviewed by a working group of the Task Force. Throughout the development of this guidebook the U.S. Environmental Protection Agency and the Federal Emergency Management Agency provided extensive comments and guidance. A revised draft was provided for final review and graphics and photographs were provided simultaneously with the completed guidebook. Following the distribution of the first printing in September 1995, overwhelming response has resulted in the printing of this updated second edition.

ACKNOWLEDGMENTS

This guidebook was prepared under the auspices of the Federal Interagency Floodplain Management Task Force with funding from U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers. Administrative support was provided by the U.S. Environmental Protection Agency, Wetlands Division. Special thanks go to Jeanne Melanson, now with the Natural Resources Conservation Service for the initial concept and support and to Cory Giacobbe and Jori Wesley of EPA and to John McShane of FEMA for their continued support, comments, and guidance. A special acknowledgment goes to Jon Kusler of the Association of State Wetland Managers for offering his valuable expertise in floodplain and water resource management.

Project research and initial writing was done by Elizabeth Myers and extra case study research by Kevin Olvany. Editing and facilitating the Tulsa workshop was done by Dr. Susan Senecah and graphics and layout were prepared by Prof. Scott Shannon. Drs. Richard Smardon and John Felleman provided overall project direction and management at the SUNY - College of Environmental Science and Forestry's Randolf Pack Environmental Institute.

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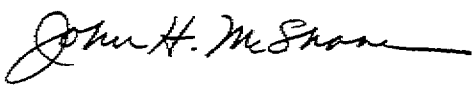
PREFACE

Floods have caused a greater loss of life and property, and have devastated more families and communities in the United States than all other natural hazards combined. In the past, efforts to reduce flood losses often relied on trying to control floodwaters, rather than encouraging people to avoid flood hazard areas. Yet, despite the expenditure of billions of tax dollars for "flood-control" structures such as dams, levees, and stream channelization, flood losses continued to rise. In addition, this structural approach frequently had adverse impacts on the natural resources and ecological integrity of our rivers and floodplains. In recent years many communities have come to recognize that the floodplain environment is an important community asset and have taken the initiative to create greenways, riverside parks, and other popular amenities. Significantly, protecting the natural resources and functions of floodplains has proven to be effective in reducing flood losses as well.

In the last few years, state and local officials, planners, engineers, property owners, and others, have requested information from Federal agencies on flood hazard mitigation methods that will preserve the integrity of floodplain systems. In response, this guidebook was prepared for local officials, and other interested citizens, to help in the development of a community action plan to protect and restore important floodplain resources and functions.

Rivers and their floodplains are dynamic and complex natural systems that can provide important societal benefits, both economic and environmental. By adapting to the natural phenomenon of flooding, rather than trying to control floodwaters, we can reduce the loss of life and property, protect critical natural and cultural resources, and contribute to the sustainable development of our communities. In towns and cities across the nation, protecting and restoring floodplain resources will enhance the quality of life for this and future generations into the 21st century, and beyond.



John H. McShane, Acting Chair
Federal Interagency Floodplain Management Task Force

1 Introduction

Statement of Purpose

"The natural resources and functions of our riverine and coastal floodplains help maintain the integrity of natural systems and provide multiple benefits for people, both material and spiritual."

This guidebook has been written to introduce you, as officials and citizens at the local level, to a basic understanding of natural resources in floodplains, and to offer suggestions for creating strategies for wisely managing these important areas. As our scientific understanding of ecosystems grows, we increasingly recognize the importance of conserving and restoring the natural resources and functions of floodplains. Historically, effective floodplain management was recognized as a necessary task to reduce the loss of life and property. However, floodplain areas are now also recognized as having an intrinsic value of their own as a part of the interconnected ecosystem and an influential role in increasing a community's quality of life. For example, the recognized benefits of a naturally functioning floodplain include the storage and conveyance of flood waters, the recharging of groundwater, the maintenance of surface water quality, and the provision of habitats for fish and wildlife. These areas also provide diverse recreational opportunities, scenic value, and a source of community identity and pride. Clearly, the potential gains of transforming stream and river floodplains from problem areas into value-added community assets are substantial. Local leaders are uniquely positioned to tap these resources for the benefit of their communities.

The overall objective of this guidebook is to help you learn about and understand floodplain management issues in order to take action toward conserving and restoring floodplain natural resources. Whereas case studies will showcase communities that have successfully implemented such projects, a step-by-step formula for universal application to all communities would be unrealistic. Rather, this guidebook is intended as a starting point and a resource for ideas so you can utilize current knowledge about floodplain natural resources in order to customize floodplain management projects to your unique local context.

Chapters 2 and 3 of this guidebook provide an explanation of natural floodplains-- their functions and importance in reducing flood losses, maintaining clean and plentiful water supplies, and generally enhancing other factors that affect the quality of life in communities. Recognizing the importance and the sensitive nature of these areas is an important first step in designing an effective strategy for stewardship.

Chapters 4 and 5 of the guidebook suggest ways to successfully plan for and manage floodplain natural resources. They provide information on establishing partnerships to include the public and private sector to identify community objectives, and encourage

creative local application of existing federal, state and private programs to achieve local goals. They also identify sources of technical information which are essential to effective management programs, and explain the importance of continued monitoring and stewardship.

Some excellent examples of floodplain management programs have emerged at the local level. A number of communities have taken great initiative, utilizing public participation to define local objectives and tapping into available resources in state and federal programs. The Case Studies at the end of the guidebook illustrate the variety of approaches that can be taken to avoid future problems in floodplains and show how to take advantage of the assets that rivers and streams can offer to a community. Finally, the References direct readers to additional sources of information and support for communities that accept the challenge to protect these vitally important resource.

A Brief History of Floodplain and Natural Resources Management

Throughout history, people have settled next to waterways because of the advantages they offer in transportation, commerce, energy, water supply, soil fertility, and even waste disposal. Many major cities are located along rivers, and even the smallest community is likely to be near a creek or stream. In spite of these benefits, however, our historic attraction to settling along rivers and streams is not without its drawbacks. Human uses of floodplains are associated with dangers both to humans and to the natural functions of the riparian or floodplain environment. Loss of property and degradation of critical wildlife habitats are just two of the threats posed by civilization at the water's edge.

Community planning is often a complex balancing act. On one hand, planners often try to dedicate a certain amount of open space for natural areas and passive recreation, or habitats for wildlife. On the other hand, planners also must be aware of the need to limit or avoid development in sensitive areas like wetlands. These objectives often intersect in natural floodplain areas, which are likely to harbor more wetlands, greater wildlife diversity, and higher scenic values, and yet are under a more intense threat of flood losses than any other area within a community. It makes sense, then, to consider combining these objectives by focusing careful attention on the wise and creative use of floodplain lands.

Unfortunately, the wisdom of such an approach can be difficult to recognize because in many communities, distinct organizations are often responsible for parts of the goals mentioned above. For example, agencies in charge of parks, recreation, or stormwater management may operate at the municipal level, while separate state or federal agencies address wetland permitting, wildlife protection, and flood insurance issues. Private environmental education organizations or environmental groups may be particularly concerned about a rare species, scenic beauty, or recreational experiences. Each of these agencies or groups has a different primary goal, yet their interests are more closely related than they may suspect because their common ground is the floodplain. Often, however, the existing processes do not afford them the opportunity to discuss their interests, share their knowledge, and plan together; hence, valuable collaborative energy is untapped.

In order to understand some alternative strategies that can be employed in managing resources in floodplains, it is essential that we become acquainted with the history of floodplain and natural resource management, especially in recent decades. Figure 2 illustrates the evolution of this need for the coordination and integration of strategies for managing floodplain natural resources. Although the time lines present an overview of the federal programs and agencies charged with managing the hazards and resources associated with river corridors throughout U.S. history, the chronology also tells the story of our evolving understanding of these dynamic systems.

***Figure 1a & 1b** - Floodplains are noted for their significantly variable character, both between different river systems and from season to season on the same watercourse...*

S. Shannon

R. Smardon

Figure 2 - Timeline of primary floodplain and natural resource management efforts in the United States.

The Frontier Era	
Pre-1917	Limited federal involvement in flood control or relief.
The Structural Era	
1917	Federal Flood Control Acts. In response to flood disasters in many areas of the country, the federal government took on the costs of constructing reservoirs, channels, dams, and levees. The Army Corps of Engineers was responsible for these efforts. This type of flood controls are referred to as "structural controls."
1928	
1936	
1938	
1950	Federal Disaster Act provided relief to flood victims.
The Stewardship Era	
1960	Flood Control Act. Corps of Engineers assists communities in planning uses of floodplains.
1965	Water Resources Planning Act combined federal and state efforts in creating river basin commissions to do comprehensive planning. Unified National Program for Managing Flood Losses sought to combine federal, state, and local efforts for comprehensive floodplain management. Evolving over several decades, this program attempted to discourage unwise development and to provide education about strategies and tools for managing floodplains.
1966	
1968	National Flood Insurance Act made flood insurance available to homeowners in communities that have implemented local floodplain management regulations. National Wild and Scenic Rivers Act.
1969	National Environmental Policy Act required broad consideration of environmental impacts before implementation of federally funded projects.
1972	Water Pollution Control Act Amendments and Clean Water Act establish a permitting system for development in wetlands.
1977	
1977	Executive Order 11988, *Floodplain Management*
1986	Water Resources Development Act made provisions for cost sharing in water projects.
1990	Omnibus Water Bill requires Corps of Engineers to consider environmental protection as one of its primary missions, and encourages the protection of wetlands; Stafford Disaster Relief Act.
1994	National Flood Insurance Reform Act

Despite the fact that the hydrology, vegetation, wildlife, and soils in floodplains are intricately connected to one another, agency programs were often designed to deal only with single aspects of floodplains, such as flood control or erosion. This single-purpose approach to management has been limiting because it did not recognize the complexity of these systems and the interdependent components of natural areas. As the connections between networks of streams and rivers, adjacent wetlands, soils, vegetation, wildlife, and people are increasingly understood, many experts have begun to encourage "multiobjective management" of river and stream corridors. This shift in approach is reflected in the time line, which shows the parallel histories of floodplain and natural resource management as each has moved toward more broad-based, comprehensive management efforts.

From the birth of the United States until the early 1900s, many federal policies and programs encouraged the development of land, a plentiful resource in a continually expanding nation. In this period, which might be classified as the Frontier Era, the common goal was to conquer the wild landscape of the young nation and to promote "productive use" of land. Flood hazards were the problem of the individual property owner or were dealt with cooperatively at the local level.

As the land became more populated and developed during the first half of the twentieth century, federal and state governments began to set aside natural areas for protection. Such legislative actions were useful, but they treated natural areas as discrete parcels and lacked appreciation for the interconnectedness between preserved areas and the surrounding land. At the same time, in response to a series of devastating flood disasters throughout the country, the federal government began to take an active role in preventing flood losses by assuming costs for the construction of structures such as dams and levees for flood control. This period, known as the Structural Era, was characterized by attempts to alter and control floodwaters and get water off the land as quickly as possible.

In the 1960s and 1970s, however, the complexity and interconnectedness of natural systems triggered in resource managers a new respect for the multiple values of natural areas. Federal agencies that had traditionally operated under single-purpose directives were charged with broadened mandates, such as considering the effects of timber management practices on water quality and wildlife. These shifts in policy heralded an Era of Stewardship for natural systems. Also during this period, despite impressive flood control engineering feats, flood losses continued to rise. In response, federal disaster relief programs were created to deal with the reality of ongoing flood losses throughout the country, and others, such as the National Flood Insurance Program, encouraged appropriate development of flood hazard areas. More recently, the lessons of natural resource stewardship have begun to influence our thinking about floodplain management, and as we realize not only the limitations of our ability to control flooding, we also realize the tremendous benefits that naturally functioning floodplain systems can offer. This realization is responsible for the shift to managing floodplains for multiple objectives.

There are three stories running through this brief history of floodplain management in the U.S.. The first is the story of our evolving understanding of the complexity of natural resource functions. The second is our recognition of limitations on our ability to control floods. And the third — perhaps the most important — is the story of shifting responsibility. Although the burden of flood hazard protection was accepted by the federal government earlier in this century, we have come to recognize that the most sensible, least costly approach to flood hazard protection may have less to do with dams and disaster relief, and more to do with land-use patterns within floodplains. In the U.S., most land-use decisions are made at the local level. This means that there must not only be a renewed emphasis on community responsibility for preventing flood losses, but also for stewardship of the valuable natural functions associated with floodplains.

St. Louis Post Dispatch

M. Campbell

Figure 3a *- The cost-effectiveness of reducing flood losses by elevating or relocating homes was dramatically demonstrated in parts of the Midwest in June, 1995. The top photograph shows an inundated mobile home park along the Missouri River during the Great Flood of '93. The same area flooded again in 1995 (bottom photograph, as the floodwaters were rising), but there was little flood damage because the families had been moved to new safe sites. Some 10,000 homes in the Midwest have been elevated, relocated, or acquired with Federal and state funds since 1993.*

The New York Times noted that relocating homes out of the floodplain "...follows a shift toward a more realistic national floodplain policy, one that takes the emphasis off trying to control nature...by moving residents out of harm's way - changing the behavior of people instead of rivers." (5/6/96)

"For years the Government spent billions of Federal dollars trying to keep water away from people. Missouri woke up and started moving people out of harm's way..."

Governor Mel Carnahan of Missouri, 1995

Aspects of the strategies of former eras still influence us in many ways — flood control structures, land-use patterns, agencies and programs, and even our thinking about these systems still reflect a single-purpose approach in many ways. Certainly we must live with some decisions of the past. But it is important to incorporate the new knowledge that is available to us, and to protect and enhance the valuable resources that are so important to the well-being of our communities. It is our hope that this guidebook will help those at the local level to successfully meet this challenge.

2 Understanding Floodplain Resources

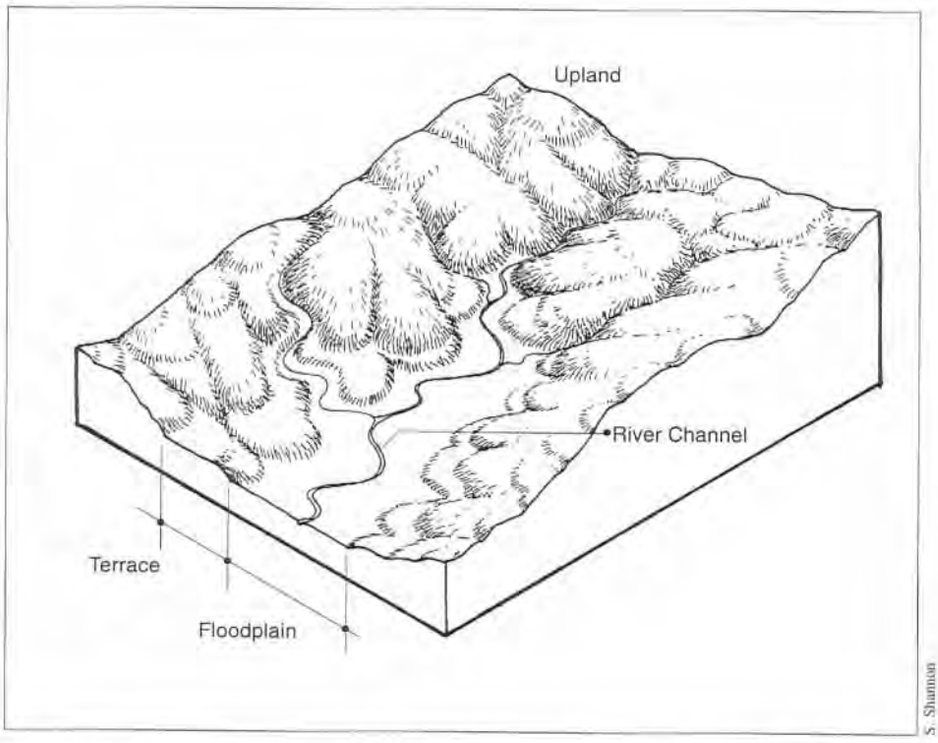
What Are Floodplain Natural Resources?

The term "natural resources" often brings to mind products, such as timber or fossil fuels that may be extracted from their natural environments and sold as commodities for profit. But the natural values of floodplains are different; their value lies not in their removal and sale, but in the functions that they perform within the floodplain environment. Floodplain natural resources include the soils, nutrients, water quality and quantity, and diverse species of plants and animals that exist in the areas between the water's edge and the higher ground adjoining flood-prone areas. These can be considered as natural "infrastructure." But what is it about these resources that make a naturally functioning floodplain so valuable? We will begin the discussion with some basic information about how floodplains are formed.

Rivers Shape the Landscape - The formation of a floodplain is intimately tied to the adjacent river or stream, which over long periods of time carves out the surface geology of the landscape and deposits sand, silt, and other material (these deposits are referred to as alluvium) that form rich soils. A typical river corridor has several features that result from the geological and hydrological processes that form these landscapes (Figure 4). The **river channel** meanders through the landscape, carving through the terrain and depositing sediment as it goes. Sediment deposits and depressions around the water's edge may result in the formation of **wetlands**, areas that are always or periodically inundated with water.

The level areas bordering river channels are known as **floodplains**. These portions of river valleys are frequently defined in terms of the likelihood of flooding in a given year. Hence, the "100-year" flood is the flood having a 1% chance of occurring during any given year. (Similar definitions can be made for the 25- or 50-year floods.) As the river cuts downward it may leave **terraces**, formed from a time when the river flowed at higher elevations. These landforms are a part of the larger river corridor, and are extremely important to the functioning of the floodplain ecosystem.

Watersheds - While the floodplain and its resources are the centerpiece of discussion for this guidebook, watersheds are central to the understanding and management of resources in floodplains. A **watershed** includes the area of land that is drained by a river and its tributaries. Different watersheds are separated from each other by ridges



S. Shannon

Figure 4 - Major physiographic elements of a typical floodplain.

or divides. Like floodplains, watersheds are formed over time by various climatic, hydrological and geological processes. But a watershed is much bigger than a floodplain and can therefore be more difficult to manage, since large land areas are usually covered by a number of separate municipalities with different governments and land-use strategies. It is important to understand, however, that upstream uses of land and water within a river's watershed are likely to have adverse impacts downstream including the potential for increased flooding.

Natural Resources and Ecosystems - Both the hydrological and the geological characteristics of the landscape play an extremely important role in determining what vegetation will inhabit the area. Many of the plant species that grow in floodplains are adapted to thrive in the specific conditions created by the soil types and water flow cycles that characterize river corridors. In turn, this vegetation plays an important role in determining how water flows across the land, and is a major factor in controlling erosion and sediment deposits that can change the face of the landscape.

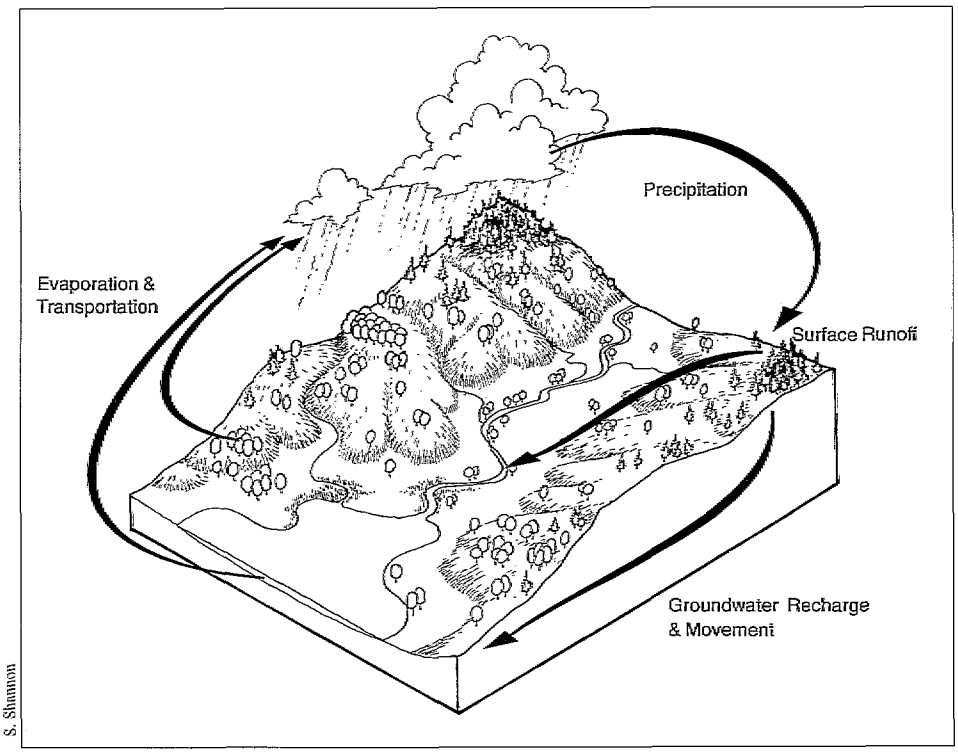
In a mutually supportive cycle, the living and nonliving parts of natural floodplains interact with each other to create dynamic systems in which each component helps to maintain the characteristics of the environment that supports it. These systems of interacting parts of the physical and biological worlds are called **ecosystems**. Together, these parts of the floodplain ecosystem function to store and convey floodwaters, protect water quality, prevent erosion, and maintain rich habitats for fish and wildlife. In recognizing the relationships between the hydrological, geological and biological features of these systems, we can begin to understand how changes to one feature can alter the entire system in significant ways. This was dramatically demonstrated during the Great Midwest Flood of 1993 when the Mississippi River reclaimed much of its floodplain. The flood reconnected the river to traditional spawning areas, resulting in a significant increase in fish populations.

Natural Communities - Throughout a floodplain and its adjacent landforms there may be a number of different **ecological communities**, groups of plant and animal species

Figure 5 - Coastal floodplains are geologically dynamic areas where moving sands, shifting inlets, and erosion are common. Coastal salt marshes are among the most productive ecosystems on earth and are a vital link in both commercial and recreational fishing.

FEMA

Figure 6 - Major elements of the Hydrological Cycle in floodplains.



that coexist in a certain area. The various plant species within an ecological community may share the need for a certain soil type or level of soil moisture that is available only in a particular portion of the floodplain. Wet meadows, bottomland hardwood forests, and riparian shrub wetlands are examples of such communities. The boundaries of these ecological communities can be identified by the landform, soil, and plant types that cover a portion of the floodplain.

Summary - This section has introduced floodplain natural resources with an explanation of floodplains, watersheds, ecosystems and natural communities. The basic characteristics of floodplains and their natural resources function in ways that make them so valuable to humans and to wildlife. This is the subject of the next section.

How Do Natural Floodplain Systems Function?

The Floodplain Ecosystem - Floodplain ecosystems are typified by the bottomland hardwood forests found in southern regions of the U.S., the floodplain forests of central and eastern areas, and small wooded areas and streambank vegetation in the western portion of the country. Each floodplain ecosystem has specific conditions that make it unique, and it is important to recognize these distinctive attributes when planning projects for a given area. But there are some general characteristics that are common to the functions of ecosystems in stream and river corridors.

Hydrology - Flooding is extremely important to the maintenance of floodplain ecosystems, and may be the primary reason for their biological richness. Floodwaters carry nutrient-rich sediments and trigger chemical processes that cause beneficial changes in the soil, which contribute to a fertile environment for vegetation. The degree of soil saturation from flooding (and resulting elevated groundwater levels) determines the types of vegetation that can grow throughout the floodplain and can create wetlands along stream channels. This is especially important in dry climates, where water is a particularly limiting factor for vegetation. In these areas, floodplains may be far more biologically productive than surrounding upland areas, which are often drier.

The ultimate determinant of the structure of floodplain ecosystems is the **hydroperiod**, or the timing (frequency and duration) and intensity of flooding. The hydroperiod, which is governed by the climate, soils, and geology of the area, determines the amount and movement of water in soils across the floodplain. This rise and fall of flowing water typically occurs at least once within the growing season. The saturation of soils for at least part of the year is one reason why wetlands tend to form in floodplains along stream channels. These hydrological features, combined with the connections to upland and aquatic ecosystems, are what make riparian ecosystems so special. (See Figure 7.)

Soils and Nutrients - The distinctive attributes of soils in riparian ecosystems are directly influenced by the hydroperiod, which determines the soil aeration (or oxygen level) as well as nutrients and content of organic material. In turn, the soil affects the structure and function of plant communities in these ecosystems. The aeration of soils is extremely important for rooted vegetation. When the corridor is flooded for long periods of time, low oxygen conditions can be created. Some plants have adaptations that help them to survive in such conditions. Soils in riparian areas (especially wetlands) generally have a high level of nutrients because of the continual replenishment of nutrients during flooding. The periodic wetting of the soil also releases nutrients from the leaf litter. (See Figure 8, page10.)

Vegetation and Habitat - Any ecosystem that forms the edge of two other distinct ecosystems tends to be more biologically diverse than its neighboring systems. This is indeed the case with floodplains, as nutrients, energy and water provide for high biological productivity. The soil conditions that result from varying amounts of moisture in soils leads to a greater diversity of plant species in riparian areas. Floodplains may be characterized by different zones of vegetation, with shallow aquatic vegetation shifting gradually to shrubs and trees toward the upland elevations. This variety in plant life translates into greater diversity of habitats for wildlife. (See Figure 9, page 11.)

Diverse vegetation can support a wide variety of wildlife and smaller organisms that feed on the plants. In addition, the trees and shrubs of upland areas offer protection and nesting and roosting areas for many species. Trees standing or fallen adjacent to the

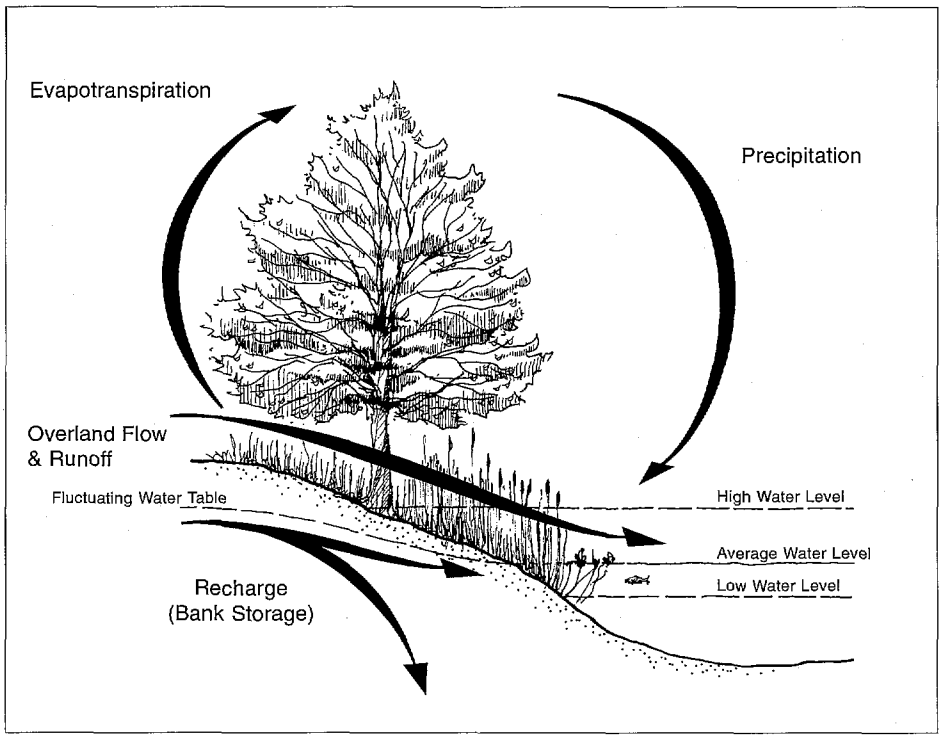


Figure 7 - Hydrologic Features in the floodplain.

Table 1 - Natural Resources and Functions of Floodplains.

❑ Water Resources

Natural Flood and Erosion Control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce peak flows
- Reduce sedimentation

Water Quality Maintenance
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperature fluctuations

Groundwater Recharge
- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface flows

❑ Biological Resources

Biological Productivity
- Rich, alluvial soils promote vegetative growth
- Maintain biodiversity
- Maintain integrity of ecosystems

Fish and Wildlife Habitiats
- Provide breeding and feeding grounds
- Create and enhance waterfowl habitat
- Protect habitats for rare and endangered species.

❑ Societal Resources

Harvest of Wild and Cultivated Products
- Enhance agricultural lands
- Provide sites for aquaculture
- Restore and enhance forest lands

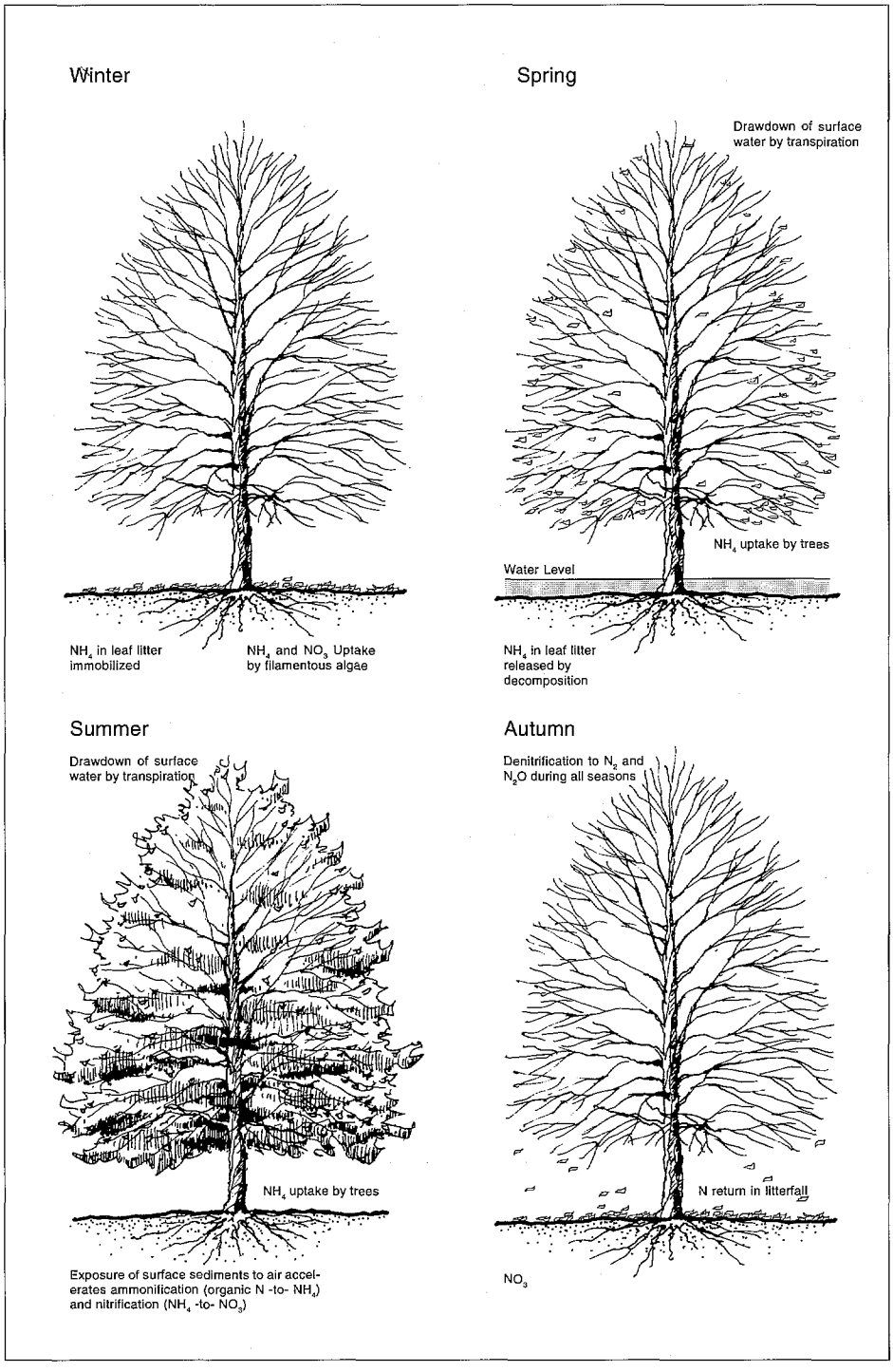
Recreational Opportunites
- Provide areas for active and passive uses
- Provide open space
- Provide aesthetic pleasure

Areas for Scientific Study and Outdoor Education
- Contain cultural resources (historic and archeological sites)
- Provide opportunities for environmental and other studies

Adapted from: *A Unified Program for Floodplain Management,* 1994.

river's edge act to stabilize its banks, while fallen branches and root masses create aquatic microhabitats in the form of pools, breaks, and ripples. A stream itself can be a source of food and cover for wildlife, and the corridors themselves offer pathways along which birds, mammals, and fish can migrate. Wetlands are particularly valuable as nesting and feeding areas for fish and waterfowl.

Vegetation and Water in the Floodplain - While the type of vegetation inhabiting a riparian ecosystem is largely determined by its hydrological conditions, the vegetation itself plays an important role in maintaining these very conditions. The interaction of


Winter
Spring
Drawdown of surface water by transpiration
NH_4 uptake by trees
Water Level
NH_4 in leaf litter immobilized
NH_4 and NO_3 Uptake by filamentous algae
NH_4 in leaf litter released by decomposition
Summer
Autumn
Drawdown of surface water by transpiration
Denitrification to N_2 and N_2O during all seasons
NH_4 uptake by trees
N return in litterfall
NO_3
Exposure of surface sediments to air accelerates ammonification (organic N -to- NH_4) and nitrification (NH_4 -to- NO_3)

S. Shannon

Figure 8 *- Nutrient Cycling in a floodplain forested wetland ecosystem.*

vegetation and water influences local microclimate conditions. Plants in river corridors provide natural floodwater storage capacity by retarding runoff and increasing the rate at which water infiltrates soils. This can result in the reduction of flood peaks downstream. Vegetation also allows the water to spread horizontally and more slowly, rather than running directly from upland areas into rivers or streams. In addition, the leaf litter and soils associated with floodplain vegetation act as sponges in absorbing some floodwaters. Vegetation also passes water to the atmosphere through transpiration.

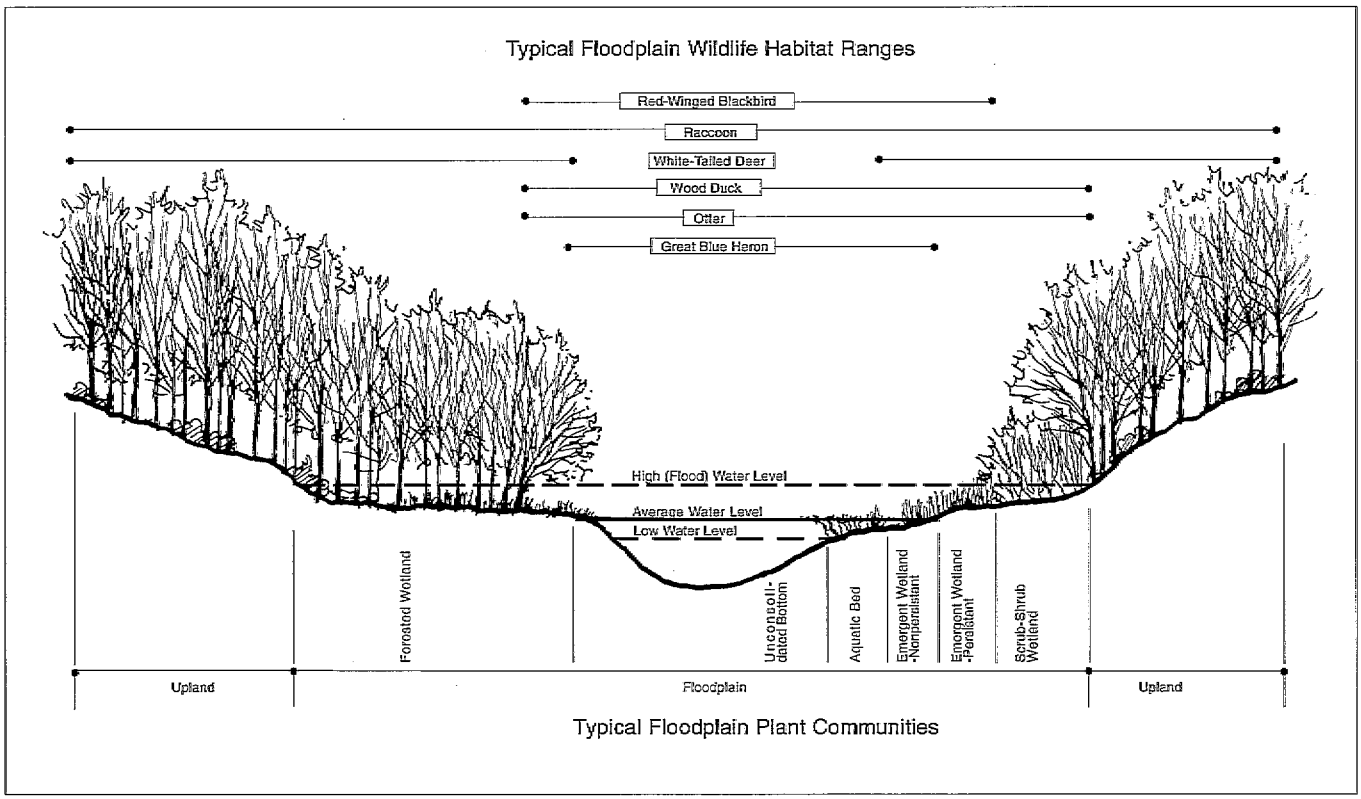


Figure 9 - The structure of plant communites and interconnecting wildlife habitats are strongly influenced by spatial and temporal patterns in the floodplain .

Surface Water Quality - Maintaining the ecological integrity of riparian areas can help to protect and even enhance the quality of surface water. This is true because of the critical role that riparian vegetation plays in these systems. First, trees and shrubs along streambeds can maintain the temperature of water by shading it. This is important as lower temperatures increase the capacity of the water to carry oxygen, which is critical for the support of aquatic life and decomposition of organic material.

Second, floodplain vegetation filters sediment and nutrients that move toward rivers and streams from upland areas. This function is crucial because excessive nutrients in aquatic ecosystems can disturb the balance and growth of species and reduce the availability of oxygen in the water. The results can include reduced diversity, unpleasant odors, and, ultimately, human health problems. The degree to which floodplain vegetation performs its filtration function is dependent on several factors, including the slope and width of the floodplain and the nature of the vegetation.

Excessive sediment in waterways can also blanket the gravel beds that are home to invertebrates such as insects and crustaceans. These creatures are an important link in the food chain, and destruction of their habitat can have far-reaching effects on other species in the ecosystem. Excess sediment can also disturb the areas in which fish eggs and young fish develop, with harmful effects on populations that may be essential to recreational fishing areas.

Groundwater Supply and Quality - Floodplains and wetlands can play an important role in contributing to sources of water supply for human consumption. The slowing and dispersal of runoff and floodwater by floodplain vegetation allows additional time for this water to infiltrate and recharge groundwater aquifers. Floodplain soils and vegetation can also help to purify the water as it filters down to the aquifer. The ability of wetlands to contribute to groundwater recharge varies with geographic location, season, soil type, water table location and precipitation, as well as wetland type.

In addition, water can also flow from higher groundwater systems into lower surface waters during periods of low flow, so that the frequency and duration of extremely low flows may be reduced. Many wetlands store water that is important for wildlife and may be used for irrigation during periods of drought.

Summary - Natural resources in floodplains interactively function to determine the distinctive attributes of soils, vegetation, habitat, and water. They also carry out valuable functions that provide benefits both to humans and to wildlife. How these functions can be encouraged or impeded by human activities on the land is the subject of the next section.

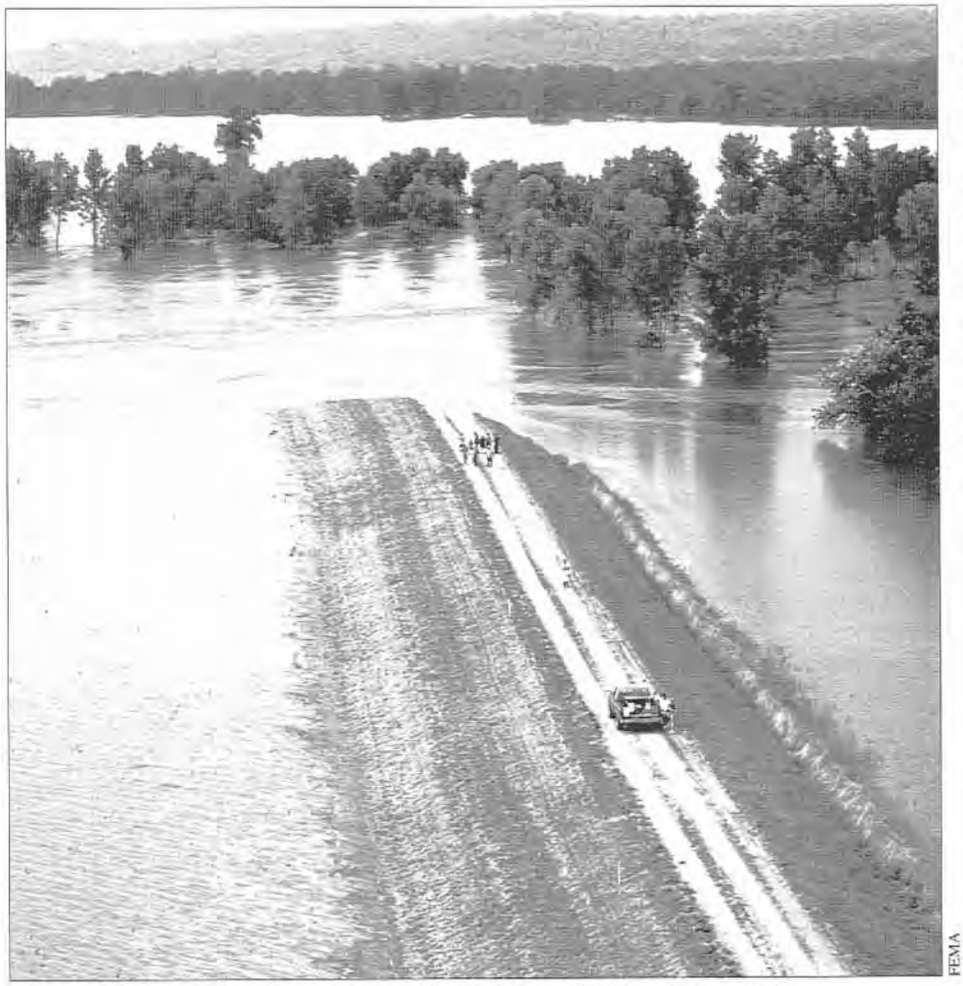


Figure 10 - *The Mississippi River reclaims its floodplain during the Great Flood of 1993.*

"...ten thousand river commissions, with the mines of the world at their back, cannot tame that lawless stream, cannot curb it or confine it, cannot say to it "Go here," or "Go there," and make it obey; cannot save a shore which it has sentenced; cannot bar its path with an obstruction which it will not tear down, dance over, and laugh at."

- Mark Twain,
Life on the Mississippi

3 Human Activity - Multiple Uses of Floodplains

"Rivers were here long before man, and for untold ages every stream has periodically exercised its right to expand when carrying more than normal flow. Man's error has not been the neglect of flood-control measures, but his refusal to recognize the right of rivers to their floodplain..."

-Engineering News-Record, 1937

While it is important to understand that natural resources of floodplains serve many valuable functions, we must recognize that humans use the land in ways that can impede these natural functions. If vegetation and soils play crucial roles in maintaining water quality and retarding runoff, then their disturbance or removal can inhibit or eliminate the functions that these ecosystem components perform. Loss of these functions should raise concerns for those communities in which floodplain land uses are not compatible.

Every community makes choices about land use. These choices will vary according to the characteristics of a particular community, and in many cases choices are limited by land-use decisions of the past. Current land-use patterns may reflect inadequate consideration or understanding of the consequences of altering natural features of the environment. Even so, it is important that an awareness of the value of natural functions is incorporated into the land-use decisions that will affect the future of any community.

Different levels of development and disruption to natural systems will have varying impacts on natural resources. For example, if the floodplain in your community is already fully developed, your management objectives will be quite different from those of a community that has a considerable amount of open space. Here are some different levels of land use development and corresponding considerations:

- Urban Areas — It is likely that the floodplain within an urban community is already highly developed. Here, the management options include restoration of natural areas and the relocation of structures that are particularly threatened by flood hazards.

- Suburban Areas/Urban Fringe — Urban fringe areas often face great development pressures, but may be fortunate enough to have some open space to work with. Effective planning is critical in these communities, and can include a focus on maintaining existing open areas along waterways and restoration of vegetation.

- Rural Areas — Agricultural communities have a different set of floodplain concerns. They have an advantage in the fact that open space is probably already plentiful in the floodplain. Management strategies here should focus on controlling erosion and excessive nutrient loadings, as well as revegetating streambanks to restore natural ecosystem functions.

- Wildlands — Communities with very low-density development and much more open space already have functioning natural systems. Local officials in these areas have the opportunity to safeguard floodplain functions at the outset, and to maintain valuable habitats and superior water quality.

It may seem burdensome to plan for the protection of natural resource functions, particularly in heavily developed areas where economic concerns and space limitations are pressing issues. But every community must recognize that decisions about floodplain resources are decisions about the community's future. With careful consideration and planning, rivers and streams can be aesthetic and functional assets that reflect community pride and ingenuity. However, a community that ignores the importance of natural floodplain functions may ultimately face flood losses and deteriorating water quality. In the end it would be less costly to plan well now.

Of course, not all human activities are incompatible with healthy, functioning floodplain ecosystems. Land uses that allow native vegetation to flourish and do not disturb soils are highly suitable within the floodplain. Well-placed parks or recreational areas that include vegetation are often ideal for maintaining flood storage capacity, and help to support the floodplain functions that protect water quality and sustain habitats for diverse wildlife species. Even open space areas such as agricultural lands can help to maintain flood storage capacity. In addition, there are proactive measures to restore naturally functioning floodplains, such as protecting or planting vegetated buffer strips and creating channel alterations for fish habitat improvement. The following sections describe specific land uses and their relationship to floodplain functions:

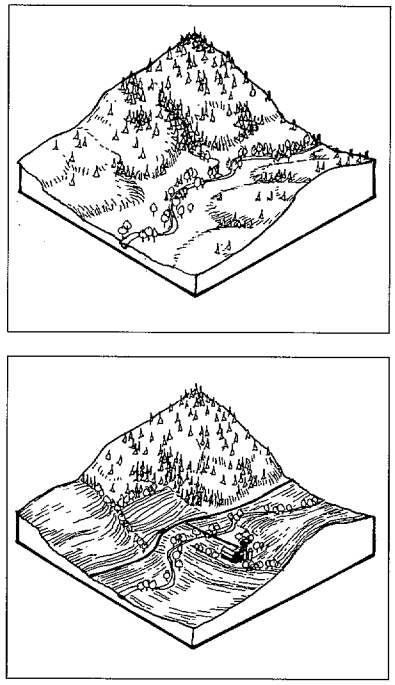
Urban and Urban Fringe Areas - Development within floodplains often occurs without consideration of the effects on floodplain natural resource functions. If an area is built up during a period when there have been few floods, the need for the flood storage capacity of a naturally functioning floodplain may have been overlooked. The loss of natural floodplain functions in heavily developed areas not only impedes flood storage, but also increases erosion and reduces the mitigating effects that vegetated areas can have on the pollution of waterways.

Impermeable surfaces such as buildings and pavement replace vegetation as ground cover, increasing the runoff that would have infiltrated in a natural floodplain. The removal of vegetation, destruction of wetlands, and paving in urban and suburban settings can thus increase the risk of flooding. Upstream development outside the floodplain can also result in increased runoff. Vegetation loss and excessive runoff within the floodplain can also cause increased erosion and sedimentation, which may cover spawning areas and bury food sources in streams. Loss of vegetation also removes sources of shelter and food for wildlife, and human-made structures may present barriers to migration and reproductive activity.

The lack of naturally functioning floodplain resources in urbanized or developing areas also has significance for water quality. Diffuse "nonpoint sources" sources of pollution related to urbanization, such as lawn fertilizers, leached materials from waste disposal areas, and chemicals leaked from automobiles, present a threat to water quality. Although it is most effective to address such problems at their source, vegetative buffers along waterways can help to mitigate such pollution. Urban areas also present direct "point sources" of pollution to waterways, such as sewage treatment plants and industrial discharge. Riparian vegetation would have little effect on this type of pollution.

Wetlands are particularly vulnerable to loss through human intervention. The draining and filling of wetlands for development and agriculture results in the loss of an important natural system for reducing runoff and maintaining the quality of surface and ground-

Figure 11 *- Floodplain development in the United States, as well as other countries, has significantly increased flood damages and often degrades the floodplain environment.*



S. Shannon

Figure 12 - Agriculture is a significant and important land use in many floodplains.

R. Smardon

water, and destroys the diversity and habitats for which these areas are recognized. In general, it is important to recognize that there must be a balance between the need for some floodplain occupancy and the tremendous benefits to be gained from maintaining naturally functioning floodplains.

Agriculture - While agricultural land uses do not impede the absorption of floodwaters as urban development does, agriculture can present other problems for floodplain resources. Fertilizers and pesticides associated with farming are major sources of nonpoint pollution of waterways. Erosion from poorly managed agricultural operations can cause excessive sedimentation in streams. The removal of vegetation along stream and river banks compounds these problems by eliminating valuable filtration functions.

Recreation and Open Space - Parks or recreation areas are one type of land use that is generally considered to be quite compatible with the healthy functioning of floodplain ecosystems. A tremendous variety of recreational activities can occur along rivers and streams. A simple trail provides an opportunity for hiking, jogging, cycling, or horseback riding, as well as increasing accessibility of the waterway to birdwatchers, photographers, and beachcombers. A more ambitious recreation plan might include provisions for water-based activities such as swimming, boating, and canoeing. Well-planned picnic or camping areas may encourage waterfront use by families, and some waterways and wetlands may be ideal for fishing or hunting waterfowl.

If recreational land uses are planned for the floodplain, it is wise to lay out a strategy carefully and to recognize the needs of different recreational groups. For example, swimming and powerboating in a narrow waterway might not be compatible activities, while pollution may detract from water recreation possibilities altogether. Wetlands may have particular value in performing natural floodplain functions, and are better suited to trails or waterfowl hunting than to picnicking. A good starting point is to take an inventory of existing recreation patterns for a waterway and of floodplain features that are unused but have potential. When planning for recreational uses of floodplains, it is important to design areas in ways that minimize potential damage. Heavy recreational use of riparian areas can destroy vegetation, thus reducing its water quality maintenance functions. Trampling off-trail vegetation can also lead to disruptions that reduce diversity of plant and animal life.

Aesthetic Resources - Scenic vistas can enrich the quality of life in any community, and are quite likely to be found overlooking waterways. Such areas make excellent targets for floodplain natural resource management plans. Existing or potential scenic areas can be identified easily with input from the public, who are most familiar with a community's special landscapes.

Cultural Resources - The centuries-old tendency of humans to settle near waterways has resulted in many historic structures and archeological sites along rivers and streams. Protecting these artifacts of our heritage may be an important part of a floodplain protection strategy.

Greenways - Greenways are linear parks or corridors of open space that may extend across many communities. They embody a strategy for keeping riverside areas largely undeveloped while providing recreational, cultural, and aesthetic resources. These chains of green may be dotted with nature centers, historic structures or other semi-open-space land uses, in addition to parks and wild areas with native vegetation. Greenways can help to protect long stretches of floodplain ecosystems, and serve as migration corridors for wildlife.

J. McShane

Figure 13 - Boulder, Colorado is a good example of a community that has taken the initiative to transform its flood hazard areas into community assets by creating greenways with wildlife preserves, parks, and bike paths.

The Floodway - The floodway is the most significant component of the floodplain, relative to maintaining the flood-carrying capacity of rivers and streams. The floodway is defined as that area of the watercourse plus adjacent floodplain land that must be preserved in order to allow the discharge of the base flood without increasing flood heights more than a designated amount. Communities are required to prohibit development within a floodway that would cause an increase in flood heights. Because a floodway is, in many respects, a *de facto* preservation tool, it also acts to protect critical riparian habitats, minimize degredation of surface water quality, and provide for greater groundwater recharge.

A number of states and local communities have adopted a more restrictive floodway which generally results in a wider floodway; thus a greater area of floodplain, especially sensitive riparian areas, would likely remain undeveloped. Some 5.8 million acres of floodways have been delineated along 40,000 stream and river miles in 7,800 communities nationwide. This is an area the size of Vermont or more than 2 1/2 times that of Yellowstone National Park.

Watersheds — The Big Picture - While it is important for communities to plan and take responsibility for the land uses that occur in their own floodplains, it must be recognized that flood level and water quality can be very much affected by land use activities that occur elsewhere in the watershed. Land uses along tributatries are likely to have an impact on downstream communities. Wise management of tributaries is therefore extremely important, as their protection can yield benefits for the entire network. Broad planning efforts among communities within a watershed can thus have far-reaching advantages.

4 Planning for Resource Protection & Restoration

"No higher duty can devolve upon the city authorities than that of protecting the property, health, and lives of the people; this is their permanent duty - a duty which cannot be evaded, nor can their right to do so be lost by neglect or bartered away."

City of Welch vs Mitchell
121 S.E. 165 (1924)
The first court case involving floodplain regulations.

Planners who value their community's long term vitality and high quality of life should support a highly participatory approach for planning resource protection and restoration in the floodplain. Building consensus among all affected stakeholders, however diverse, best provides an opportunity to establish mutually supportive partnerships and offers the obvious benefits of commitment to basic goals and objectives and more meaningful implementation. Initially, however, any group must decide on a basic organizational approach. Options might include allowing all planning and resource acquisition to be accomplished by:

- ❑ a government agency
- ❑ a private nonprofit association
- ❑ a public-private partnership

Whichever organizational option is chosen, a community approach is needed that involves various, diverse stakeholders in planning floodplain use and management, e.g., land owners, resource managers, local government, environmental advocates, and agricultural and business interests. One of the best ways to start is to do an informal reconnaissance—just invite people to walk the floodplain area together. In the process, the members can start to compile natural resource information as well as floodplain management problems. This is a time to collect ideas, not debate priorities or approaches. This process might need to be repeated, depending on the number and interest of stakeholders. The key is to build ownership of the decision-making process by providing opportunities for all stakeholders to contribute. These experiences should generate a fairly comprehensive list which may include needs, concerns, desires, problems, issues and even solutions from which goals and objectives can be developed. Goals should reflect more general directions and objectives should delineate the more specific means of accomplishing those goals.

Next, choose an approach among single purpose, multiple purpose or comprehensive planning. If the issues are very focused and small in scale, a single purpose approach may be appropriate, e.g., such as creating a river floodplain park. Most groups opt to use a multiple purpose approach; that is, to work simultaneously to meet several needs, e.g., preserving wildlife habitats, reducing flood losses and enhancing water quality in the floodplain.

A comprehensive holistic approach looks at an entire watershed or floodplain as an interrelated environment and attempts to satisfy numerous needs while utilizing a long range vision. This watershed approach requires the planning group assess two major items: the resources necessary to undertake the plan; and the organization appropriate to oversee actual watershed assessment and management. Adjoining communities must be agreeable to dedicating their own efforts to a collaborative process.

The chosen approach also implies how the floodplain planning group will be organized, e.g., private, public, agency driven, private-public partnership, etc.. As noted earlier, the authors urge the planning group to use a participatory approach that involves all stakeholders and allows for as much participation as possible within the various planning tasks. Once the group is organized, goals and objectives are initially set, and a planning approach is specified, then the planning group is ready for floodplain assessment. The following offers some basic steps for assessment:

Figure 14 - The planning process works best when all stakeholders are involved.

S. Shanaan

Figure 15 - Inventorying floodplain resources in the field.

R. Smardon

Step 1: Identify the Planning Area.

Obtain a base map of the principle drainages and sub drainage basins as well as the floodplain area. Planning should include all the land area from which floodplain problems are perceived to arise. This might include an entire watershed, but more likely will include a section of the floodplain and a land area of not fewer than several hundred feet landward from the banks of a stream or river. The area delineated should not include less than the "100 year" floodplain and should remain flexible because the boundaries may change as information becomes available and updated. As an example, some areas, such as latter tributary buffer zones, may or may not actually lie within a definite floodplain. The maps of your community's floodplain provided by FEMA are a good place to start.

Step 2: Conduct an Inventory and an Analysis of Land Use and Environmental Concerns.

Broad stakeholder participation is important for the inventory and analysis stage. Participation is useful because as stakeholders become familiar with the floodplain natural resources and management issues, this paves the way for more understanding and agreement on management and implementation steps (see Figure 14).

Choose a reference scale that will be consistent for all maps. This is important so that all recorded information will facilitate accurate comparison of data in analyzing development trends and environmental constraints (see Figure 16).

Natural and Cultural Resource Inventory and Assessment

The first stage of the inventory should be the collection of data regarding the natural and cultural resources in the planning area. For each category of resource data, we have suggested a particular, appropriate resource as well as participatory opportunities in the Table above. The table is illustrative of the types of information needed for the natural and cultural resources inventory. The key is to gather enough information to understand how floodplain natural resources and functions are part of an ecosystem, e.g. how the vegetative communities and wildlife depend on local water levels and flows. Particular attention should be focused on areas needing special management or protective measures, e.g. wetlands, wildlife and fisheries habitat, water bodies, and habitats of rare and endangered species.

The inventory should be based on reliable and acceptable sources of information such as those indicated in the middle column; however, opportunities abound for local participation in data acquisition if this work is carried out in a methodical manner (see Figure 14). In fact, some types of information, such as scenic resources, are best inventoried by local citizens. Information might also be obtained from regional and local

Table 2 - Natural Resource Data Categories, Sources, & Participatory Options. Acronyms and abbreviated agency names:

DNR = Department of Natural Resources or equivalent state agency
FEMA = Federal Emergency Management Agency
NRCS = Natural Resources Conservation Service
NWS = National Wetlands Inventory
USFWS = United States Fish and Wildlife Service
USGS = United States Geological Survey

Category Option	Expertise Source	Participation
surficial/bedrock geology	USGS office files surficial/bedrock maps	field trip to identify land forms apparent
soils, soil depth, erodibility, soil structure wetness, percolation & slope	NRCS office & published county soil survey, county extension agent	field trip to sample soil types & attributes
vegetation types & species	existing vegetation mapping aerial photos, local vegetation experts state natural heritage program	field trip for identification & major veg. communities
surface & ground water hydrology, water quality class	USGS office files state env. quality office	limited fieldwork options - note hydrologic surface features
aquifers & recharge areas-water bodies	USGS files & maps	limited fieldwork
historic/archeological sites & districts	local historians & archeologists	look for local historic archeologic studies & maps
wetland location & assessment	USFWS office & State DNR office	fieldwork to check NWI maps or state agency for wetland existence, equivalent & vegetation health
fish & wildlife habitat by species	state fish & game office or USFWS surveys	fieldwork to observe wildlife & fish during different seasons
rare & endangered plant & animal species	consult local experts or existing surveys in study area & USFWS	check for lists of endangered species or the area - combine w/fieldwork
floodplains & areas of tidal inundation	Check existing FEMA maps	look for flooding not on existing maps
areas of outstanding scenic quality	look for any existing visual perception surveys	do local surveys, e.g., nominate scenic areas & self-employed photography

planning agencies, county environmental management councils, and local conservation advisory boards or equivalents. Many of these agencies have prepared natural resource inventories, open space indexes, and natural resource plans.

The next step is to assess the existing functions and benefits that the natural resources in the planning area provide to the community. This assessment would include functions such as flooding reduction, nutrient cycling, biological diversity and habitat support, maintaining water quality as well as open space benefits including recreation, aesthetics, heritage and cultural resource maintenance.

Existing Land Use and Development Trends

Evaluate existing land use including county and local economic development trends in the planning area that may impact it. Include in the evaluation such growth inducing factors as current and anticipated major public and private capitol investments, including:

- ❑ industrial expansion
- ❑ major commercial development
- ❑ suburban residential development
- ❑ development of natural resources (e.g. forestry, mining, recreation, etc.)
- ❑ other social and economic trends

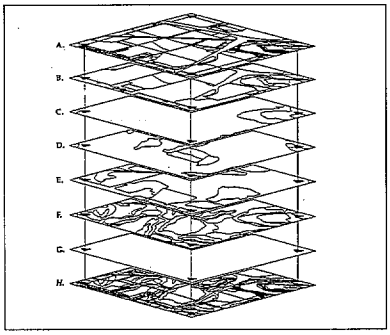
The evaluation should include:

a) development that has occurred over the last few years,

b) current development activities that are influencing the patterns and magnitude of growth, and

c) development now in the early stages of planning which may impact the river or stream corridor in the future. The evaluation should show patterns and intensity of land use in the planning area, including urban and non-urban uses planned for undeveloped areas. The relative density and zoning classification, i.e. industrial, commercial, residential, etc., should be mapped, especially if the need for urban, urban fringe, or expanding land use is apparent. Obviously, if the community is primarily rural or wild land — this may be less of an immediate issue; however, projecting all future land use possibilities is always wise.

Figure 16 - The inventory of environmental characteristics, such as flood zone, land use, and vegetation types is best accomplished by mapping each characteristic individually. The synthesis of this information requires the ability to consider multiple characteristics and their spatial interaction, such as through the use of weighted overlay analysis or computerised GIS modelling.



Adapted from R. Hawks

Environmental Analysis

Information from the natural resources inventory should be used to evaluate growth and development in the planning area such as floodplains, critical wildlife habitats, high erosion potential, historic landmarks, scenic vistas, high ground water table, wetlands, etc.. This can be done in a number of ways.

The first way is a weighting of factors from the natural resources inventory as constraints to development ranging from "slight" to "moderate" to "severe." Transparent overlay maps with shades of gray corresponding to the three levels of constraint can be juxtaposed to indicate the degree of constraint or incompatibility with proposed land use development (see Figure 16). This is called a weighted overlay method.

Another approach is to look at the functions (benefits) provided by the natural floodplain environment such as flood minimization, nutrient cycling, biological diversity, water quality maintenance, contribution to ground water supply and quality, as well as open space functions. The question is to what degree existing or proposed development impacts or reduces these functions (benefits). If these functions are valued, specific controls or performance conditions should be placed on future development in the floodplain such as no net loss of flood storage or conveyance capacity, alteration of existing hydrological processes, disruption of existing habitat values, perceptible change in landscape character, or reduction in open space, etc.. The focus is not so much about a particular land use being incompatible; the focus is more about designing particular land uses or activities so they do not impact the existing ecosystem functions. One could even go further and describe restoration of lost functions in an urban or heavily impacted floodplain.

A third approach is to involve the local stakeholders in discussing and prioritizing both:

1) the floodplain natural resource values and functions
2) development issues.

In this way, some intermingling of local development needs and natural resource protection could be achieved by facilitating town meetings, advisory boards, even negotiations or mediation rather than dictating "professional planning" directives. Such stakeholder discussions are needed if realistic, supported implementation is expected.

In undertaking whatever approach is selected for the environmental analysis, it is useful to consult with other planning agencies, environmental management councils, conservation commissions, and professional resource managers to assist in the classification and interpretation of information in the natural resource inventory.

Step 3: Conduct a Problem and Need Assessment

This is one of the most important steps in the assessment process. Problems and needs can be separated into three categories:

- ❑ in-stream problems
- ❑ floodplain corridor problems
- ❑ watershed problems

In-stream Problems and Needs

In-stream problems and needs directly affect the bed and banks of the water body. Problems include, for example, destruction of fisheries habitat through stream channelization, removal of stream bank vegetation, sedimentation, and problems related to the pollution of the stream bed including debris and wastes, affecting both water quality and aesthetics. The location of these problems and sources should be mapped on a base map overlay or some other information storing devise such as a geographic information system. Management needs such as fisheries management, water quality management, floodplain management, recreation development, restoration or rehabilitation of scenic resources, etc. should be discussed and linked to implementation.

Floodplain Management Problems and Needs

The floodplain is the land that normally has the greatest influence on the quality and character of a river, stream or creek. A stream or river is most vulnerable to sediment from erosion and runoff which originates in the corridor. It is also vulnerable as a result of the heat gained through the removal of a corridor's vegetative canopy. Thus, flood-prone areas and land activities in the corridor which adversely affect a river, stream or creek should be identified and mapped - especially if they are related to agriculture, forestry, construction/urban encroachment, or mining activity. A description should be made of these activities and how they are impacting the water body or associated wetlands, for example, whether it is a quality or quantity alteration of the ecological structure (see functional analysis in the earlier assessment section). Professional resource managers from your state Department of Natural Resources (DNR) or equivalent, County Soil and Water Conservation Districts, County and local planning agencies, and environmental management councils should be consulted as necessary.

Watershed Management Problems and Needs

If local communities are to protect and conserve the resources of the streams, creeks and rivers—they may have to look beyond the watercourse and corridor and consider the watershed in its entirety. Because of the cause-effect relationships of the various processes inherent in the land use of streams, creeks, and rivers, water courses serve as an index of the health of the entire watershed. Accordingly, water management problems such as non-point pollution that are related to various land use activities that extend beyond the stream corridor and which are more watershed wide concerns should be described and mapped if the planning group opts to include a watershed wide approach.

Step 4: Define the Corridor Management Boundary

While no precise scientific formula for determining the optimum boundary location for any given corridor management unit can be offered, completion of the preceding steps should help in establishing a "floating" working boundary.

A floating flood plain conservation and management corridor varies in width according to the location of important natural resource features and environmental constraints that exert a strong influence on the character and quality of the stream and its surroundings. Wooded areas, wetlands, flood plains, scenic vistas, and areas having land use constraints, such as steep hillsides or soils having high erosion potential, should be included in the management corridor. However, it may be adequate to focus on the floodplain areas as delineated in your flood maps provided by FEMA.

Step 5: Develop an Action Plan/Agenda

The next step is to move from problems and opportunities to developing an action plan for implementation of various measures that might be needed to protect natural resources in the flood plain. It is especially at this stage that maximum participation of all stakeholders is needed. Ideally, meaningful public participation has been continuous up to this point.

To create an action plan or agenda, there are three activities:

- ❑ review goals/objectives and philosophical perspectives;
- ❑ create the Action Agenda; and
- ❑ determine the sequence of events.

For the first activity, when developing and reviewing your goals and objectives, you can find guidance in the President's letter transmitting the 1994 document *A Unified National Program for Floodplain Management* to the Congress:

> [The Unified National Program] recognizes the importance of continuing to improve our efforts to reduce the loss of life and property caused by floods and to preserve natural resources and functions of floodplains in an economically and environmentally sound manner. This is significant in that the natural resources and functions of our riverine and coastal floodplains help to maintain the viability of natural systems and provide multiple benefits for the people.

It is in this spirit that your organization should review basic goals and objectives as well as adopt and overall strategy to protect floodplain resources.

According to "A Unified National Program in Floodplain Management" (1986 & 1994) two basic strategies can be employed to protect a floodplain's natural resources:

1.) *Preservation of Resources*: Preventing alteration of floodplain natural and cultural resources, and maintenance of the flood plain environment as close as possible using all practical means.

2.) *Restoration of Resources*: Re-establishment of a setting or an environment in which natural functions can again operate.

Preservation strategies focus on strict control or prohibition of development in sensitive or highly hazardous areas (through establishment of wildlife sanctuaries, for ex-

ample) while restoration strategies focus on actions to improve the quality or functioning of degraded floodplains (by restoring damaged wetlands, for example). It is not always possible, however, to make a clear distinction between the two strategies. Preservation and restoration of floodplain natural resources are often accomplished, either directly or indirectly, through a wide variety of development controls or by means of regulatory standards designed to protect valuable natural resources or minimize adverse impacts to those resources.

Preservation strategies do not exclude management activities that are compatible with sustaining floodplain functions. Preservation strategies, for example, can include activities to improve habitat conditions and the nonpoint pollution control functions of forests at the water's edge. Types of regulatory activities and management programs that directly or indirectly contribute to the restoration and preservation of living resources/habitat resources include:

- ❑ single and multi-purpose resource protection and management programs that include objectives for habitat and living resources protection that apply to floodplains
- ❑ incorporation of provisions for protection of habitat and living resources in zoning, subdivisions, and other land-use regulations that apply in whole or in part to floodplains
- ❑ incorporation of specific provisions related to living resources and habitat protection in floodplain management programs and regulations.

These kinds of programs can be directed toward inland and coastal wetlands, estuarine and coastal areas, barrier beaches and sand dunes, rare and endangered species, riverine and coastal fisheries, and wild and scenic rivers. Most of the nation's wetlands, coastal barriers

Table 3 - Strategies and Tools for Floodplain Management - Source: Federal Interagency Floodplain Management Task Force. *A Unified National Program for Floodplain Management.* Washington, D.C.: Federal Emergency Management Agency, 1986, 1994.

STRATEGY - Modify Susceptibility to Flood Damage and Disruption:

- ❑ floodplain management land use regulations
- ❑ building codes
- ❑ acquisition/relocation
- ❑ development and redevelopment policies
- ❑ information and education

STRATEGY - Modify Flooding:

- ❑ dams, levees, floodwalls
- ❑ channel alterations
- ❑ land treatment measures
- ❑ on-site detention facilities

STRATEGY - Modify the Impact of Flooding on Individuals and the Community

- ❑ flood insurance
- ❑ disaster assistance
- ❑ information and education
- ❑ tax adjustments

STRATEGY - Protect and Restore the Resources and Functions of Floodplains:

- ❑ floodplain, wetland, and coastal barrier resources regulations
- ❑ land use planning
- ❑ conservation easements
- ❑ watershed management
- ❑ tax adjustments
- ❑ information and education

and marine sanctuaries are located within riverine and coastal floodplains, and restoration and preservation of the living resources and habitat resources of floodplains are often accompanied through multi-objective programs or regulations aimed at protecting inland wetlands, coastal wetlands and barrier islands.

Preservation and restoration of floodplain water resources has been accomplished through a variety of water supply, watershed management, agricultural erosion control, and water quality maintenance and improvement programs.

Protection of floodplain cultural resources has been accomplished through open space and recreation planning and urban renewal programs, especially in older cities where early settlement concentrations occurred in the floodplain. Some of these programs include waterfront redevelopment projects, historic and cultural resources protection programs, and a variety of multi-purpose open space programs including programs that focus on the development of water-oriented recreation, public access and greenbelts.

The second activity is to create the Action agenda utilizing strategies from Table 3 with specific tools from Table 4. For each action come up with preliminary answers for the following questions, remembering that none of them are carved in stone, but can be changed as needed.

Who will take responsibility for initiating and implementing the action? One group could take the lead role, or the work could be shared among a number of groups or individuals. If no firm commitment to take a leadership role exists, consider ways of generating interest in carrying out this action in the future, rather than immediately.

How will the action be taken? Break it down into main components. For example, creating a riverfront bike trail could involve meeting with elected officials, fundraising, preparing a slide show to publicize the effort, and asking a local university for design assistance.

When will the action be taken? Sometimes a fixed deadline is approaching that will determine your timeframe. For instance, a hearing date may be scheduled for a proposed flood protection project. In other cases you may need to know only that a given action, such as a water quality monitoring program, should be accomplished within the next year or by the end of the following summer. Perhaps one action will begin only after another is completed. These timeframes provide a general guide for planning your work.

The third activity is to determine the sequence of events. The action agenda outlines a framework for taking actions in a logical sequence leading to the fulfillment of your natural

TOOLS FOR:

FLOOD STORAGE AND CONVEYANCE:

- ❑ Minimize floodplain fills and other actions that require fills, such as construction of dwellings, factories, highways, etc.
- ❑ Require that structures and facilities near wetlands provide for adequate flow circulation.
- ❑ Use minimum grading requirements and save as much of the site from compaction as possible.
- ❑ Relocate non-conforming structures and facilities outside the floodplain.
- ❑ Return the site to natural contours.
- ❑ Preserve free natural drainage when designing and constructing bridges, roads, fills and built-up centers.
- ❑ Prevent intrusion on and destruction of wetland, beach, and estuarine ecosystems, and restore damaged dunes and vegetation.

Table 4 - Examples of Tools for Protecting and Managing Natural Floodplain Resources. - Source: Federal Interagency Floodplain Management Task Force. *A Unified National Program for Floodplain Management.* Washington, D.C.: Federal Emergency Management Agency, 1986 & 1994.

Table 4 - (Continued.)

WATER QUALITY MAINTENANCE:

- ❑ Maintain wetland and floodplain vegetation buffers to reduce the build-up of sediments and the delivery of chemical pollutants to the water body.
- ❑ Support agricultural practices that minimize nutrient flows into water bodies.
- ❑ Control urban run off, other storm water, and point and nonpoint discharges of pollutants.
- ❑ Support methods used for grading, filling, soil removal, and replacement, etc. to minimize erosion and sedimentation during construction.
- ❑ Restrict the location of potential pathogenic and toxic sources on the floodplain, such as sanitary landfills and septic tanks, heavy metals wastes, etc.

GROUND WATER RECHARGE:

- ❑ Require the use of permeable surfaces where practicable and encourage the use of detention/ retention basins.
- ❑ Design construction projects that eliminate, reduce, or hold back runoff.
- ❑ Dispose of spoils and solid waste materials so as not to contaminate ground and surface water or significantly change the land contours.

LIVING RESOURCES AND HABITATS:

- ❑ Identify and protect wildlife habitats and other vital ecologically sensitive areas from disruption.
- ❑ Require topsoil protection programs during construction.
- ❑ Restrict wetland drainage and channelization.
- ❑ Reestablish damaged flood plain ecosystems.
- ❑ Manage timber harvesting and other vegetation removal.

CULTURAL RESOURCES:

- ❑ Provide public access to and along the waterfront for recreation, scientific study, educational instruction, etc.
- ❑ Locate and preserve from harm historical and cultural resources; consult with appropriate government agencies or private groups.

AGRICULTURAL RESOURCES:

- ❑ Minimize soil erosion on cropped areas in floodplains.
- ❑ Control, minimize, or eliminate the use of pesticides, herbicides and fertilizers.
- ❑ Limit the size of fields and promote fence rows, shelter belts, and strip cropping for improved wildlife habitat.
- ❑ Strengthen water bank and soil bank type programs in a manner consistent with alternate demands for use of agricultural land.
- ❑ Minimize irrigation return flows and excessive applications of water
- ❑ Eliminate feedlot-type operations.
- ❑ Discourage new agricultural production requiring the use of drainage.
- ❑ Retain agricultural activity on highly productive soils where flood risk is compatible with the value of the crops grown.

AQUACULTURAL RESOURCES:

- ❑ Construct impoundments in a manner that minimizes alteration in natural drainage and flood flow. Existing natural impoundments such as oxbow lakes and sloughs may be used with proper management.
- ❑ Limit the use of exotic species, both plant and animal, to those organisms already common to the area or those known not to compete unfavorably with existing natural populations.
- ❑ Discourage mechanized operations causing adverse impacts. Machinery such as dredges, weeders, and large scale harvesting equipment may lead to environmental problems such as sediment loading in adjacent watercourses.
- ❑ Use extreme caution in the disposal of animal waste.

FORESTRY:

- ❑ Control the practice of clear-cutting, depending on the species harvested, topography, and location.
- ❑ Complement state laws governing other aspects of harvest operations such as proximity to water courses, limits to road building, equipment intrusions, etc..
- ❑ Include fire management in any overall management plans. Selective burning may reduce the probability of major destructive fires.
- ❑ Require erosion control plans on all timber allotments, roads and skidways.

resource conservation goals. An effective action agenda will show concisely the scope of your whole effort, but it is not specific enough to include all the tasks that will actually go into the work. Organizing your time, resources and people is often necessary to make actions come to life. Not every action or event will require a detailed list of tasks, but in many cases a complex project becomes more manageable when broken down in this way.

What you can do to get started is to make lists of everything and everyone you will need as part of the major actions. These lists can be arrayed on a time-line by weeks or months, and ordered in a logical sequence. People can be assigned to the tasks and deadlines can be set for each step. Once you're satisfied that this process will lead you in the right direction - producing the maximum results with the minimum effort - you are set to begin.

This is where talking and planning end and action takes over. Your assessment of floodplain natural resources and issues, your public involvement efforts, goal-setting and selection of alternatives have led you to this point. You have given form to your ideas and you are ready to achieve results.

Final Step 6 - Implementation and Monitoring of the Action Plan

Once an action is begun, it generates its own momentum, and its success is sometimes difficult to evaluate objectively. It is important to keep track of your progress to be sure that you are accomplishing your floodplain conservation goals, as outlined in the action agenda. Are you meeting the timeframe that you expected? Are the responsible parties continuing to carry out their actions? If not, should responsibilities be shifted or shared with another group?

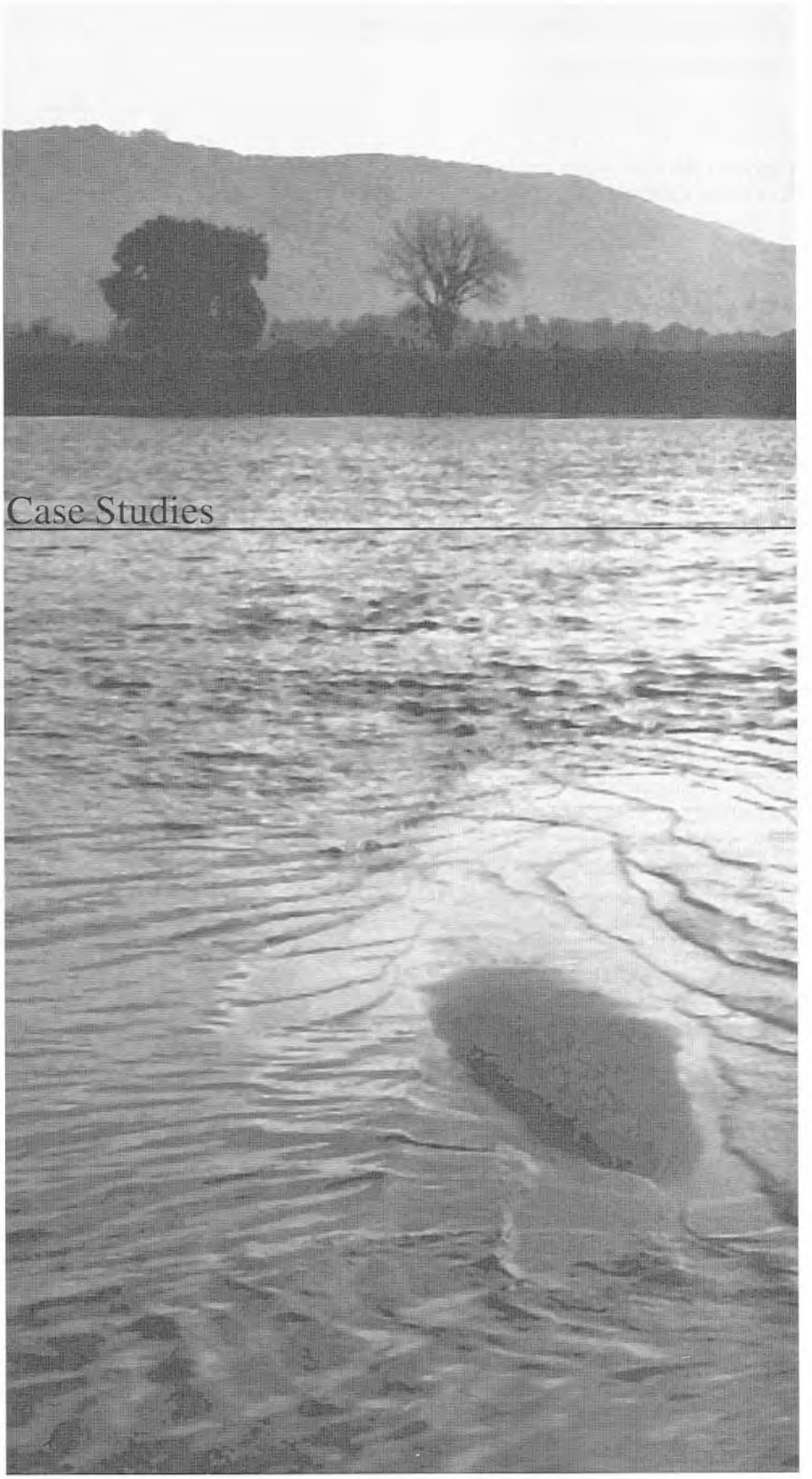
While monitoring your work, it is also important to continue to publicize your efforts, with an eye toward continuously expanding your base of support. Periodic public events - an annual floodplain festival, a traveling slide show, a clean up day - are good ways to achieve this purpose, and to keep the public aware of the river as a valued resource. Events also serve as a way to celebrate your progress and show appreciation for those who have worked with you. A scheduling chart for implementation can also include monitoring activity as well. Communities should be aware of the opportunity to integrate with the National Flood Insurance Program's Community Rating System to acquire open space as this will result in lower flood insurance rates. Monitoring is another opportunity for broad participation of the stakeholders and should include assessing current status of floodplain resources and problems as well as implementation progress.

A good example of the development of an effective action plan is the recent effort to protect the New York City water supply. Over a period of years, the quality of the surface water in a number of reservoirs has degraded due to increasing development and other activities within the watersheds. To meet safe drinking water standards, a water treatment plant costing upwards of $8 billion would be needed if the quality of the water supply could not be maintained. The City and State of new York, local communities within the watersheds, and environmental groups worked together to develop a watershed management plan that would protect water quality while still allowing for economic development. Although there were a number of contentious issues, and it took several years to formulate, an agreement was reached by all the stakeholders. This is not only a good example of the planning process working, but also clearly demonstrates that economic growth and environmental quality are mutually compatible goals. However, it will be a number of years before the efficacy of the plan can be fully evaluated.

J. McShane

Figure 17 *Though still meeting safe drinking water standards, some of New York City's 19 reservoirs have been adversely impacted by runoff and other non-point source pollution in recent years. Protecting floodplain resources throughout the watershed, such as by preserving and restoring vegetated riparian buffers, will help to maintain and enhance the drinking water for over 9 million people.*

5 Case Studies



Wildcat and San Pablo Creek

North Richmond, California

Background

For years flooding was a major problem in the unincorporated community of North Richmond, California. The impoverished community faced annual floods as a result of overflowed creeks and poor drainage, and more serious floods every few years. During the 1940s and 1950s, the Army Corps of Engineers conducted a study of Wildcat and San Pablo Creeks, but decided against launching a project to remedy the community's problems because the low value of the structures in North Richmond's floodplain made a flood control project unjustifiable in the government's cost-benefit analysis.

***Figure 18** - Location Map*

During the 1970s, the U.S. Department of Housing and Urban Development approached the community with a "Model Cities Plan" aimed at promoting social well-being, environmental quality, and economic redevelopment. The plan was initiated with a cost-benefit analysis that finally enabled the community to get federal help for its flooding problems. The citizens of North Richmond responded favorably and worked enthusiastically with the Corps of Engineers to create a flood control plan that also included such community enhancing features as recreation areas and landscaping. But the plan collapsed when the community was unable to raise the 50% funding that it was required to pay for certain aspects of the project. In the early 1980s, the County Board of Supervisors created a scaled-back plan that addressed only the flood control aspects of the project. But some citizens still had visions of a plan that could serve a wider range of the community's needs. After the scaled down, take it or leave it, "Selected Plan" presented by the County Board of Supervisors, a community coalition (made up of citizens and interested organizations) came up with its own plan (Modified Plan) and also showed the inadequacies of the Selected Plan. They attended public meetings and forced the County to listen to their plan. They used a 1960's participation strategy known as advocacy planning by soliciting their own paid and unpaid experts to develop the Modified Plan. The multi-objective stream corridor management effort that resulted when this coalition came together provides a great example of how an impoverished community empowered themselves and accepted the challenge to direct their own future.

A. Riley

***Figure 19** - Wildcat Creek near the marshlands of San Francisco Bay*

Implementation

The coalition was determined to come up with a floodplain management strategy that also addressed environmental concerns and broader community needs. They presented their plan at public meetings as an alternative to the Selected Plan. After heated debate between the two plans the County Board of supervisors approved the Selected Plan. However, the Selected Plan did not meet a series of regulatory approvals because of environmental deficiencies with their plan. The two creeks were classified by the State as one of the last remaining streams in the area with an almost continuous riparian environment. The Selected Plan would have created an ugly concrete and earth lined channel destroying much of the natural setting. Also, there were major concerns that sedimentation would disturb the marsh and wetland areas. Further, high maintenance costs would be incurred by the local community for the periodic cleaning of the channels where sediments would build up.

A new design team was then formed out of a crisis situation caused by the lack of support for the project on the part of State and Federal regulatory agencies and by the negative publicity of the Selected Plan, and not out of the philosophy of consensus planning. The design team was made up of representatives from both plans and they were to build the "Consensus Plan", which combined both environmental and flood control goals.

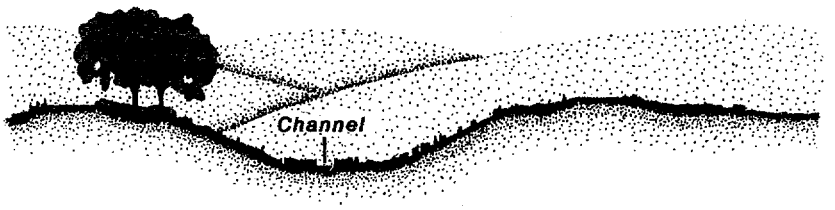
The planning process for the Consensus Plan was crucial in creating a plan that would break the 29 year logjam. The process considered all the relevant stakeholders to be co-equal and allowed the community of North Richmond to determine its own fate. The planning sessions were grueling, but unbiased leadership and inclusion of all interested parties made the meetings successful. Implementation of the Consensus plan began two years after its inception, breaking the stalemate.

Funding for the Consensus Plan was critical to the project's success. The project's broad range of objectives made it eligible for funding from agencies unable or unwilling to contribute to single-objective flood control ventures. Citizen groups in this impoverished community found funding through government agencies, foundations and environmental groups. The East Bay Park District provided funding which was matched by the Corps of Engineers for connecting a regional trail system to the two creeks and to create a nature study area. This idea was originally in the Model Cities Plan but funding was unavailable at that point.

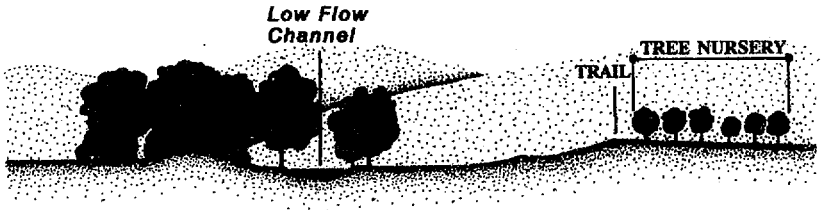
Natural Resource Protection Opportunities

Unlike most waterways in the San Francisco Bay area, Wildcat Creek is still endowed with riparian habitat along its entire length. For this reason, team members felt that it would be a mistake to replace the natural streambanks with concrete channels. Instead, they modelled the channels after natural features, using meandering, low-flow channels and planting streamside trees whose shade would prevent bullrushes from growing and obstructing flow in the waterways. These strategies enabled the project to stay within the 180-foot right-of-way required by the Selected Plan.

Experts working with the Coalition suspected that sedimentation would be aggravated by the flood control project, damaging wetlands and reducing the channels' capacity. Because of the propensity of many Western areas for flash flooding and associated erosion and even mudslides , the Consensus Plan's design adopted a wetland transition zone with high-velocity low-flow channels upstream to ensure that sediment would be deposited upstream and in the bay, where it would be least harmful.



1982 SELECTED PLAN (ORIGINAL)



1986 CONSENSUS PLAN (FINAL)

Adapted from the National Park Service

Figure 20 *- These cross-sections illustrate the two alternative creek channel designs for Wildcat and San Pablo Creeks. The original 1982 plan utilizes a typical box cross-section, high-capacity channel with little or no adjacent floodplain; the 1986 plan eventually implemented includes a shallow low flow channel with floodplain intact allowing trails, tree nursery, etc.*

Summary

There were three key aspects of the Consensus Plan that made it an innovative accomplishment. Citizens, unable to participate in the planning process, can stall a project for years and dramatically increase its cost through law suits and hearings. This can be seen through much of the North Richmond case. Probably through default, citizens were finally allowed an active role in the Consensus Plan. This feeling of empowerment made them part of the process and allowed the plan to go through much more quickly. The average time spent planning a US government assisted flood-control project before construction begins is 26 years; North Richmond took 33 years. The second aspect was the multi-objective nature of the plan. With all the varying interests involved the plan had to satisfy their needs. Although multi-objective planning is much more complex, the benefits can increase substantially. Funding for multi-objective planning increases because state and federal agencies are much more apt to fund these type of projects. Also a high level of participation can attract financial contributors and political support which can only be positive. The third aspect was the use of the creeks natural features to convey the "100 year" flood instead of using a purely structural approach. The sediment loads were taken care of much more easily, the aesthetic values remained substantially untouched and the natural setting was enhanced to convey the flood.

Case study adapted from Ann Riley. 1989. "Overcoming Federal Water Policies: The Wildcat-San Pablo Creeks Case" *Environment* 31(10), pp. 12+.

Contact: Coalition to Restore Urban Waters, 1110 Chaucer St., Berkeley, CA 94702

Blackstone River National Heritage Corridor

Massachusetts and Rhode Island

***Figure 21** - Location Map*

Background

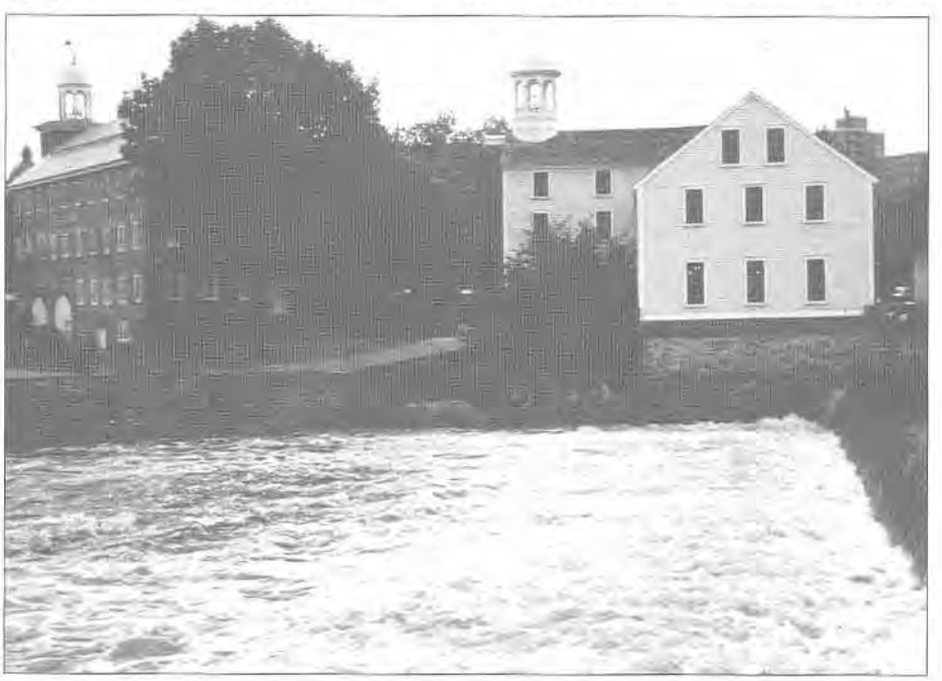
The Blackstone River Corridor was a center for industrial development in the eighteenth and nineteenth centuries, when the river's potential as a power source attracted industry and workers to the area. The region is noted as the birthplace of the American Industrial Revolution, and by the late nineteenth century the Blackstone was dubbed America's "hardest working river," with the corridor serving as home to a booming textile industry. During the 20th century, the area experienced economic decline, as textile production increasingly shifted to southern states. Years of industrial stagnation and neglect have spared much of the historical and natural landscape from destruction. However, a new demand by people to settle in this region has raised concern over a possible haphazard suburban sprawl.

Today, the region is nationally recognized as the site of an important part of America's cultural heritage. Its designation as a National Heritage Corridor is the basis for a renewed sense of pride and has spurred efforts to preserve valuable aspects of the past while revitalizing the present. This corridor, which is 46 miles long and spans two states, is the subject of a coordinated effort among federal, state and local governments, as well as many private interests.

Implementation

In 1986 the federal government passed legislation authorizing the creation of the Blackstone River Valley National Heritage Corridor Commission. Made up of representatives from the National Park Service, state and local governments, and private citizens, the federally created Commission has no legal authority to enforce preservation of the corridor. Nor does the federal government own or manage land in the Blackstone River Valley. Instead, the federal government contributes 50% of the funding for the work of the Corridor Commission, and works in partnership with the states and localities in activities such as comprehensive planning, technical assistance and environmental education. Much of

***Figure 22** - View of the Blackstone River at Slater Mill, a designated National Historic Site built in 1793.*



J. McShane

the work on the corridor is performed by state and local governments working with private businesses and nonprofit organizations to protect the resources of the valley.

Each of the two state governments involved handles its relationship with the Commission and localities differently. The Rhode Island Office of State Planning requires towns to adopt comprehensive plans with certain mandatory components. This provides an opportunity for the state to set standards that each community will follow, and affords some degree of coordination in overall land use planning efforts.

The Central Massachusetts Regional Planning Commission, in contrast, simply offers advice and coordination assistance to localities, while comprehensive planning is left up to the initiative of each community and is not mandatory. In both Massachusetts and Rhode Island, multiple state agencies bring expertise to the management of the corridor's economic, historic, and natural resource elements.

Local governments play a key role in managing the corridor, because it is their planning, zoning, and general land use management strategies that will ultimately have the greatest impact on the corridor's landscape. Thus it is very important for communities within the corridor to coordinate their planning efforts. The commission's role is to help facilitate comprehensive planning. Their strategy emphasizes integrated, linked actions rather than single, stand alone projects. Balanced action in each of these areas is critical to achieving harmony among preservation, recreation and development.

The private sector also has an important role to play, as capital investment in the maintenance and restoration of the natural and cultural resources in the corridor contributes to the overall quality of life in area communities and attracts tourism to historic towns. Many of the historic sites are being restored and used in different capacities. The restoration of many of the old mills has increased tourism in the area and old factory sites are being reincarnated as schools, retirement homes, libraries and parks. The local residents overwhelmingly support the plan which would increase tourism in the area.

"I had not seen this corridor before, and I saw... an extraordinary landscape of history, of generations of empathy and relationship to the land a river once again alive with fish, a second revolution taking place... and I said, take me further..."

-Bruce Babbitt, Secretary of the Interior, July 1995

Resource Protection Opportunities

One of the Blackstone River Corridor's greatest assets is its "working landscape" — a combination of farms, villages, cities and riverways that are a part of the region's cultural heritage. Preservation efforts focus largely on historic and cultural resources from the industrial revolution, such as Slater Mill (America's first factory) and the ethnically diverse communities that emerged as waves of immigrants came to the booming region to find work.

The commission's efforts also include recommendations for protection of water quality, vegetation and open space. The industrial boom and subsequent economic decline took a toll on the "hardest working river" by becoming one of America's most polluted rivers. Consequently, part of the commission's goal is to take steps that will contribute to improving the river's water quality, through such measures as encouraging the use of vegetative buffers by landowners adjacent to river. Also conservation easements and land trusts are two methods now being used to try and preserve the corridor. While there are opportunities and widespread support for developing parks and recreation areas along the river many sections remain underutilized. Currently a bike path spanning the entire length of the river is now being built by the two states. The bikeway, along with nature trails and boating on the river will open the riverway to local families and visitors for recreation. Projects that link Valley-wide resources will be priorities for the commission. Another key component to cleaning up the river is to increase enforcement of illegal pollution discharges along the river. Although the river has become cleaner much progress can still be made.

J. McShane

***Figure 23** - View of the Blackstone River with a Great Blue Heron. These magnificent birds have returned to the Blackstone in recent years, indicating improved water quality in the river and adjacent wetlands.*

The commission, through its recommendations, has tried to create a vision for the Blackstone corridor which, at its core, would preserve the Valley's cultural heritage. Its concentration of mill villages and towns separated by extensive rural landscape is a characteristic feature that the commission does not want to lose. Preserving and enhancing the cultural and natural landscape are goals which the commission hopes will promote tourism and revitilize the Blackstone Valley.

Contact: Blackstone River Valley National Herritage Corridor; One Depot Square; Woonsocket, RI 02895; (401) 762-0250..

Verde River Corridor Project

Arizona

Background

The Verde river in Arizona runs through a variety of terrains, beginning in forested mountains, then flowing through grasslands and desert. The river corridor has tremendous scenic character, as well as diverse ecosystems, which are particularly valuable in a state that has many dry regions. The floodplains represent a large proportion of the habitats available for plants and animals in the state. The Verde is one of the few rivers in Arizona that is still perennial, and it also flows freely for two hundred kilometers. Because the Verde is one of the last significant "natural" rivers left in Arizona, there is increasing concern that uninhibited development and destruction of habitats along the waterway might threaten the viability of its ecosystems.

Although there was no official mandate to implement a river corridor project for the Verde River, state agencies and local citizens were eager to protect the valuable cultural and natural features of the landscape while also maintaining the economic vitality of the region. A proactive river corridor project was initiated featuring a high level of public participation.

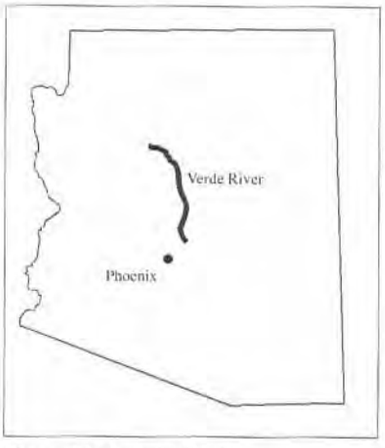
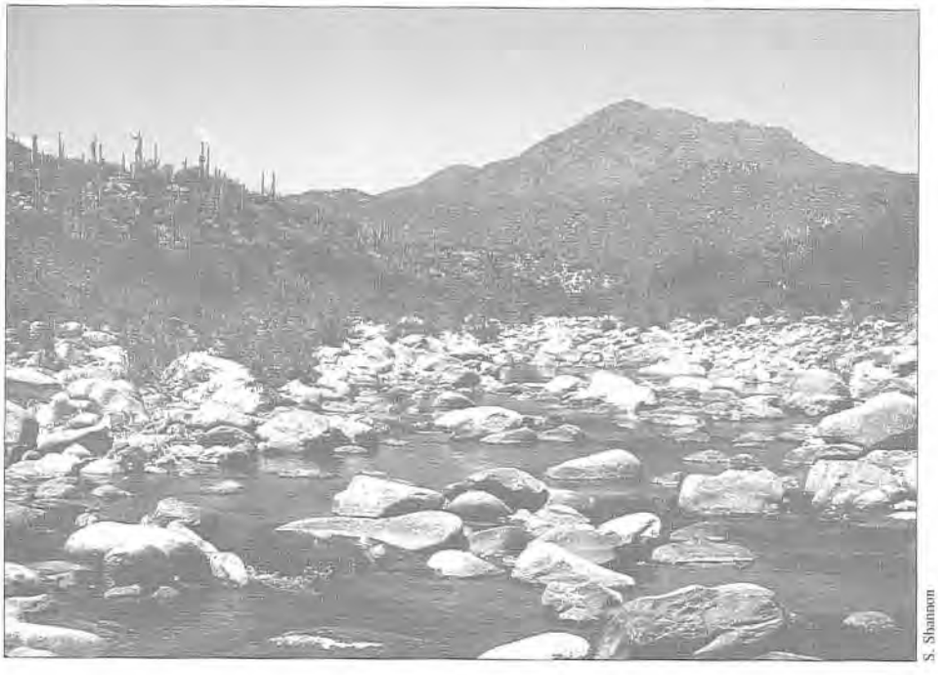


***Figure 24** - Location Map*

Implementation

Past efforts to protect the Verde have met with varying success. A 9.7 km greenway was established in the early 1980's and residents in 1989 initiated a Verde River Days festival to promote awareness and appreciation of the river. However, efforts to comprehensively protect the Verde have fallen short. In late 1989, the Arizona Department of Commerce (ADOC) initiated discussions about the river's future. The planning principles used were encouraged by the National Park Service (NPS) and the early meetings were facilitated by the ADOC and Arizona State Parks Board (ASPB). Citizens groups, businesses, universities, and private organizations were to be responsible for issue identification, decision making, and information gathering for the project. Representatives of state and federal agencies acted as facilitators in public meetings and as sources of



S. Shannon

***Figure 25** - View of the Verde River north of Phoenix*

technical expertise. The ASPB organized several public meetings, distributed questionnaires, and kept people informed of the project through mailings.[1]

A steering committee was created to direct the planning process, and it included 26 people representing all the different stakeholders. The issues to be dealt with were broken down into five categories that were addressed by different subcommittees: (1) economic and commercial uses of the river, (2) land conservation, (3) private property, (4) recreation, and (5) water. Steering committee members plus other active citizens of the communities affected made up the subcommittees. The subcommittee members drafted reports and recommendations and presented their findings to the steering committee in a public forum. A very diverse steering committee voted on the recommendations presented by the subcommittees and reached consensus on an overwhelming majority of the issues involved. A report from the steering committee was then produced for all the local communities within the watershed. The local communities then decided which recommendations they would adopt.

Land along the Verde River falls under federal, state, local and Native American jurisdictions, and a significant portion of the land is in private ownership. Maps created by project workers showed floodplain data, vegetation types, land use, slope, and land ownership. Area residents participated in a visual assessment study identifying areas of great scenic quality in the valley. Tools recommended by the committees for managing land along the corridor included greenways and conservation easements. The committees also recommended the use of published reports for use by local governments and individuals, covering such topics as legal issues, and the rights and responsibilities associated with private property ownership. A watershed association was formed to deal with water resource issues throughout the basin.

Although the plan is still in early stages of implementation, many of the recommendations of the VRCP report are being adopted by the local communities. Those involved assert that the planning process itself has helped to make the communities in the Verde basin more aware of what is necessary to protect the river corridor's valuable resources. Also because the communities within the VRCP were active participants in the planning process they were more apt to accept and use the recommendations made by the VRCP. The current success of the VRCP can be attributed to many different factors. However, a few stand out: local empowerment, effective project facilitators, and high citizen participation. The VRCP was not controlled by an agency; it was a cooperative approach between citizens and the government.

Resource Protection Opportunities

The agriculture and ranch-related features of the corridor's landscape are important parts of the heritage of the region, and serve to provide open space. Conservation easements and tax relief were two recommendations made to ensure that agricultural lands remain part of the corridor's landscape. Also to enhance water quality, instream flow, and to lower water bills, the Economics and Commercial Uses Subcommittee recommended that farmers, irrigation companies, conservation groups, and state agencies work together to develop more efficient irrigation practices. The Environmental Defense Fund gave a presentation on the potential water conservation savings that could be achieved by municipal, industrial, and agricultural sectors of the Verde Valley. Sand and gravel mining are also important economic enterprises that affect the landscape because much of the mining occurs in or near river beds, thus destroying vegetation and causing increased erosion. Educational brochures were recommended on the laws and procedures that must be followed when doing such work near rivers. In addition, the USFS initiated land exchanges with mining companies for the land the USFS owns in order to move sand and gravel operations away from the river.

F. Steiner

Figure 26 *- The Verde River upstream near Cottonwood.*

Land conservation concerns addressed in the project included the protection of wetlands and riparian ecosystems, restoration of abandoned sand and gravel sites, and protection of the tremendous scenic values of the Verde River corridor. In addition, an inventory was conducted to determine archeological and historic sites along the river. Recreation was also an important issue, as it is related to both the economic advantages of tourism and the general land conservation issues.

Water quality was a major concern, as the corridor's groundwater is the principal public watersource of the region and surface water is used for irrigation and recreation. A major recommendation from the Water Subcommittee was to establish a permanent entity to protect water resources within the Verde valley. Substantial progress has been made to establishing the Verde Watershed Association (VWA) which will help local communities plan for future water needs and ensure sufficient flows in the river.

This case study was based on: E. Averitt, F. Steiner. R. Ammerman Yabes and D. Patten. 1994. "An Assessment of the Verde River Corridor Project in Arizona." *Landscape and Urban Planning* 28(2-3), pp. 161-178.

[1]The U.S. Environmental Protection Agency (EPA) recognized the community and state's desires to grow economically while valuing and protecting their aquatic resources, and in 1989, initiated enforcement actions to bring sand and gravel miners that were excavating riverbeds into compliance with the Clean Water Act (CWA). In addition, EPA began an Advanced Identification (ADID) to qualitatively identify and map the functions and values of the river, work with the public and government entities to recognize present and future needs in and along the river, and to provide guidance as to which of these areas are likely to be suitable or unsuitable for future filling pursuant to §404 of the CWA. The findings of the ADID provide guidance to state and local planners concerning the likelihood of getting permits for future river-related fill activities. The Advanced Identification was completed in 1994 and the sand and gravel sites were restored by 1995.

Chattahoochee River

Atlanta, Georgia

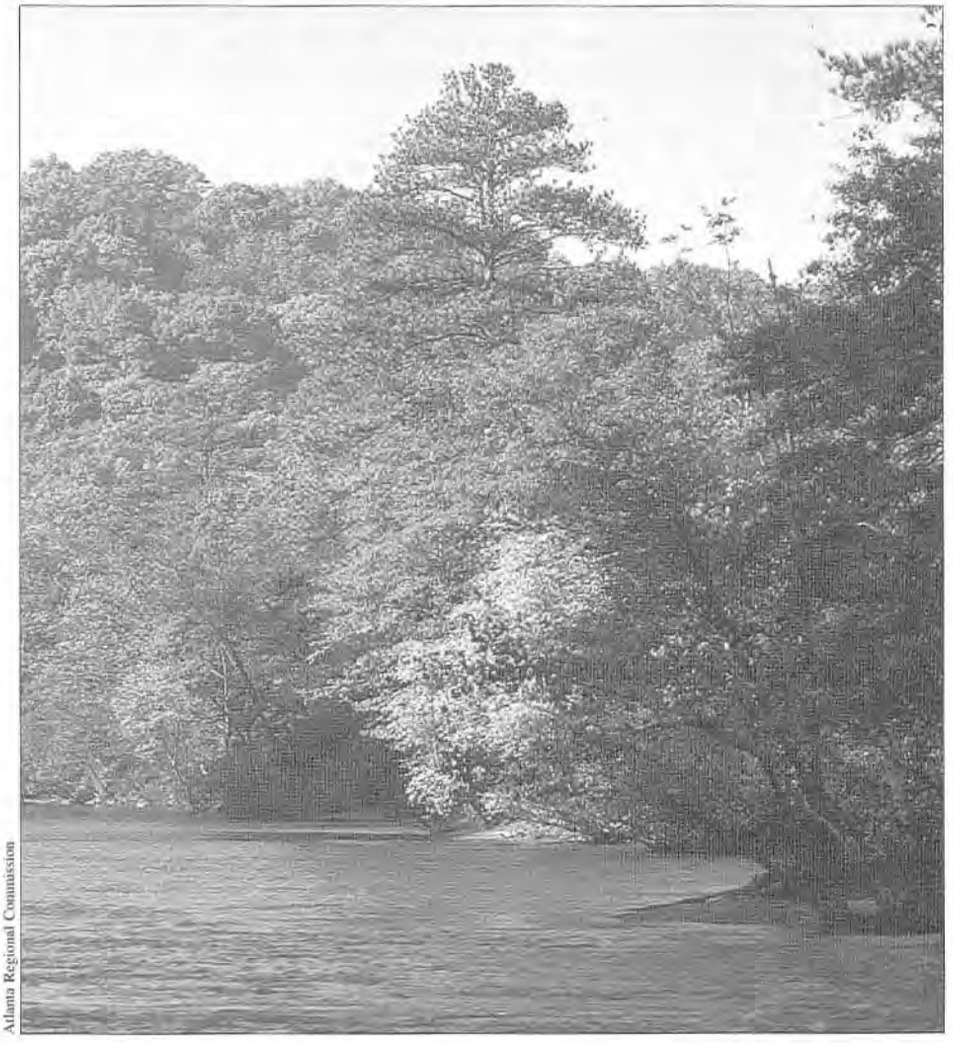
Figure 27 - Location Map

Background

The Chattahoochee River originates in the Appalachian mountains of northeastern Georgia. The river flows southwesterly through Atlanta and joins the Flint River which then empties into the Gulf of Mexico. The area of major concern for the Chattahoochee's ecological integrity is a 48 mile section which flows through the city of Atlanta and its surrounding suburbs. North of Atlanta, the river flows through a rapidly developing area of narrow floodplains and steep-walled valleys. In Atlanta the river crosses areas of industrial development and urban sprawl, yet it is still considered by many to be one of the most unspoiled and scenic rivers within a metropolitan area of the U.S.

The Chattahoochee River supplies over seventy percent of the drinking water to the Atlanta Region. In addition to supplying water for one quarter of Georgia's population, it provides many diverse recreation and educational opportunities, spectacular views and numerous historic sites, and assimilates treated wastewater from the city of Atlanta. The multitude of diverse cultural amenities provided by the Chattahoochee makes it the lifeblood of the rapidly expanding Atlanta region. With this rapid expansion, concern was raised about the long-term health of the river and its related environment. Several

Figure 28 - The Chattahoochee near Atlanta



Atlanta Regional Commission

protection proposals from state and federal agencies were debated and the Georgia General Assembly considered the Metropolitan River Protection Act (MRPA), in 1971, which would protect water supply rivers in regions with populations over one million people. During this period the newly established Atlanta Regional Commission (ARC), which is made up of local elected officials and citizen appointees, conducted a comprehensive management study on the river within the Atlanta region and made recommendations on future growth along the Chattahoochee corridor. Based on the findings of the ARC the MRPA was passed in 1972 and required a comprehensive plan for the Chattahoochee. The ARC then developed a plan of action which maintained a natural river corridor and integrated conservation with development within the growing metropolitan area of Atlanta.

Implementation

From the beginning the ARC structured goals based on the notion that the Chattahoochee would remain an urban river. The primary objective was to preserve the water quality of the river. Additional objectives that were incorporated into the plan were protection of scenic, historic and other unique areas, respect for private property rights, prevent erosion, siltation and the intensity of development, and provide for location and design of land uses. During the planning process the ARC included citizens and interest groups in the meetings to get their feedback.

The ARC studied and inventoried the natural settings of the Chattahoochee corridor to determine where future development should take place. It was recommended that more vulnerable zones remain undisturbed or be developed at low densities. Areas that were considered less vulnerable were appropriate for more intensive development. The MRPA established a 2,000 foot protection zone corridor along each side of the river including the streambed and all river islands. The Act gave local governments responsibility to implement the plan by reviewing and permitting development, monitoring land disturbing activities and enforcing restrictions in accordance with the Act and the plan within the corridor. The Act also gave the ARC responsibility to review permits that were approved by local governments. If the ARC does not agree with the permit the local governing body must have a two-thirds majority in order for the permit to go through.

Natural Resource Protection Opportunities

All land in the corridor was placed into six categories based on its vulnerability to development. Maximum limits on land disturbance and impervious surfaces were set for each category. Buffer zone standards were also set which required fifty feet of vegetation be left in its natural state along the banks of the river and 35 feet along the banks of streams flowing into the Chattahoochee. Within 150 feet of the river, the plan generally prohibited any structures or impervious surfaces except for walking paths and bridges. Floodplain standards were also set requiring that the floodplain storage and conveyance function should not be altered from its present state.

One of the main objectives of the plan was to ensure that the location and design of land uses minimize the adverse impact of urban development on the river's water quality. Development and growth will take place. It is the ARC's goal to provide the information and technical assistance to local governments so development occurs on land least vulnerable to modification. Another purpose of the plan is to use the Chattahoochee as a centerpiece to promote recreation, education and community well being within the Atlanta region. With proper planning, the Chattahoochee is not only a water supply, but a place where people can congregate and enjoy a natural setting within a metropolitan area.

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